THE AMERICANA

A Universal Reference Library

Comprising the
Arts and Sciences,
Literature, History, Biography,
Geography, Commerce,
etc., of the world

EDITOR-IN-CHIEF
Frederick Converse Beach
EDITOR SCIENTIFIC AMERICAN

MANAGING EDITOR
George Edwin Rines

ASSISTED BY MORE THAN ONE THOUSAND
EMINENT SCHOLARS AND AUTHORITIES

Issued Under the Editorial Supervision
of The Scientific American

SIXTEEN VOLUMES

Scientific American
Compiling Department
258 & 260 Fifth Avenue
New York

A Few of the Leading Articles in Volume Seven

WRITTEN AND SIGNED BY SPECIALISTS

FLOUR INDUSTRY, THE.....Henry L. Little
Manager Pillsbury-Washburn Flour Mills Co., Ltd.

FOOD, PRESERVATION OF.....Samuel W. Abbott
Of the Massachusetts State Board of Health

FORESTRY IN THE U. S.....Gifford Pinchot
Chief of the Bureau of Forestry, Washington, D. C.

FORTIFICATIONS.....Gen. Henry B. Carrington, U. S. A.
Author Military Text Books

FRATERNAL SOCIETIES IN AMERICA.....Frank Gaston
President of the Grand Fraternity

FRIENDS, SOCIETY OF.....Edwin P. Sellew
Publisher of 'The Friend,' Philadelphia

FUNGI.....Charles E. Bessey
Of the University of Nebraska

FURNITURE, COLONIAL.....Louise Cowperthwaite
Of Geo. C. Flint Co., New York

FURNITURE INDUSTRY IN AMERICA.....George W. Gay
President Berkey & Gay Furniture Co., Grand Rapids, Mich.

GAS AND GAS MAKING.....Walton Clark
Superintendent United Gas Improvement Co., Philadelphia, Pa.

GAS, ILLUMINATING.....Sidney Mason
President Welsbach Co., Philadelphia

GEMS AND GEM SCULPTURE.....George F. Kunz
Gem Expert, Tiffany & Co., New York

GEOMETRY, CARTESIAN; GEOMETRY, MODERN ANALYTICAL..Cassius J. Keyser
Professor of Mathematics, Columbia University

GEOMETRY, ELEMENTARY PURE.....Edward Kasner
Instructor in Mathematics, Barnard College, Columbia University

GEOMETRY, HISTORY OF ELEMENTS OF.....David Eugene Smith
Professor of Mathematics, Teachers College, New York

GEOMETRY, NON-EUCLIDIAN.....George Bruce Halsted
Professor of Mathematics, Kenyon College, Gambier, Ohio

GEOMETRY, PURE PROJECTIVE.....Edwin Bidwell Wilson
Instructor in Mathematics, Yale University

GERMANY, MODERN.....Munroe B. Smith
Professor of Roman Law and Comparative Jurisprudence, Columbia University

GETTYSBURG.....Gen. E. A. Carman
War Department, Washington, D. C.

GLACIERS.....John Muir
Geologist, Explorer, and Naturalist

GLASS MANUFACTURE IN AMERICA.....James Gillinder
Of the Franklin Flint Glass Works, Philadelphia

GLUCOSE AND GLUTEN.....F. M. Barrett
Of the 'American Grocer,' New York

GOSPELS.....J. S. Riggs
Of the Auburn Theological Seminary

GOTHIC ART AND ARCHITECTURE.....Russell Sturgis
Author of 'Dictionary of Architecture'

GRAPE CULTURE.....George J. Vance
Editor 'American Wine Press,' New York

GREGORIAN CHANT.....Joseph Otten
Organist Epiphany Church, Pittsburg, Pa.

GUATEMALA.....Marrion Wilcox
Authority on Latin-America

GUNNERY.....Philip R. Alger
Of the U. S. Naval Academy, Annapolis

KEY TO PRONUNCIATION.

ä	far, father
ā	fate, hate
a or ă	at, fat
ã	air, care
ạ	ado, sofa
â	all, fall
ch	choose, church
ē	eel, we
e or ĕ	bed, end
ė	her, over: also Fr. *e*, as in *de; eu*, as in *neuf;* and *oeu*, as in *boeuf, coeur;* Ger. *ö* (or *oe*), as in *ökonomie.*
ẹ	befall, elope
ẽ	agent, trident
ff	off, trough
g	gas, get
gw	anguish, guava
h	hat, hot
h or н	Ger. *ch*, as in *nicht, wacht*
hw	what
ī	file, ice
i or ĭ	him, it
ï	between e and i, mostly in Oriental final syllables, as, Ferid-ud-din
j	gem, genius
kw	quaint, quite
ṅ	Fr. nasal *m* or *n*, as in *embonpoint, Jean, temps*
ñ	Span. *ñ*, as in *cañon* (căn'yŏn), *piñon* (pēn'yŏn)
ng	mingle, singing
nk	bank, ink
ō	no, open
o or ŏ	not, on
ô	corn, nor
ȯ	atom, symbol
ọ	book, look
oi	oil, soil; also Ger. *eu*, as in *beutel*
ö or oo	fool, rule
ou or ow	allow, bowsprit
s	satisfy, sauce
sh	show, sure
th	thick, thin
tħ	father, thither
ū	mute, use
u or ŭ	but, us
ů	pull, put
ü	between u and e, as in Fr. *sur*, Ger. *Müller*
v	of, very
y	(consonantal) yes, young
z	pleasant, rose
zh	azure, pleasure

' (prime), " (secondary) accents, to indicate syllabic stress

THE ENCYCLOPEDIA AMERICANA

Flameng, Francois, frän-swä flä-män, French painter: b. Paris 1859. He began his art studies under his father, Leopold Flameng (q.v.), the engraver, and studied subsequently under Cabanel, Hedouin and Jean Paul Laurens. He is an artist of distinguished ability as a figure painter, and among the most striking works of his are: 'The Girondins Summoned' (1879); 'The Bowlers' (1886); and 'Grolier and Alus,' which last hangs in the Grolier Club of New York.

Flameng, Leopold, lā-ō-pōl, French engraver: b. Brussels 22 Nov. 1831. He began his studies in 1853, at Paris, where he became domiciled. He acquired great versatility in styles, both old and new, and did illustration work for periodicals and books, frequently for the 'Gazette des Beaux Arts.' His complete mastery of technique, and his artistic breadth of treatment render him one of the best line-engravers of the day.

Flameng, Marie Auguste, mä-rē ō-güst, French painter: b. Jouy-aux-Arches, near Metz, 1843. He has studied under Delaunnay and Puvis de Chavannes. He exhibited for the first time in 1870, and four years later began to paint coast and marine subjects. In this department he continues to maintain a high reputation and his picture in the Luxembourg, 'Fishing Boats at Sea' (1881), is a typical example of his vigorous handling, his fine color tone and briskness of movement in sea and air.

Flamingo, flā-ming'gō, a peculiar web-footed bird of the group *Phœnicopteri*, which may be regarded as intermediate between the storks and the ducks, the long legs and necks giving it a resemblance to the former, while the webbed feet connect it with the latter. There are six species of true flamingoes, widely spread over the warmer regions of both hemispheres. Our North American species (*Phœnicopterus ruber*), once common all along the southern shores of the United States, but now almost exterminated even from Florida, and ranging southward to the Argentine Republic, is light vermilion with brighter wing coverts. The other forms are rosy white (scarlet on the wing coverts) with black wing-quills. All have small goose-like bodies, but the long legs and neck give them a height of four or five feet. Their most extraordinary part is the bill, which is large, swollen and bent upon itself so that the upper half is turned downward when the bird feeds, with its head twisted and crown downward. The edges of both upper and lower jaw are furnished with small transverse plates, which serve, as in ducks, for a sieve, allowing the escape of the mud, but retaining the small worms, crustaceans, mollusks, fishes, etc., on which the birds feed. The upper surface of the tongue is beset on the sides and base with flexible, recurved, horny spines. Flamingoes live and migrate in large flocks, warning one another of danger by a loud trumpeting note, which is the signal for the flock to take wing. When flying, they form a triangle.

They breed in companies in mud-flats or inundated marshes, where they spend most of their time wading about, raising up the mud into a small hillock, which is concave at the top so as to form a nest. In this hollow the female lays her one egg, and hatches it by sitting with her legs doubled up under her. The young, usually two in number, do not fly till they have nearly attained their full growth, though they can run very swiftly and swim with ease almost immediately after their exclusion from the shell. This bird was held in high repute among the luxurious Romans; and Apicius, so famous in the annals of gastronomy, is recorded by Pliny to have discovered the exquisite relish of the flamingo's tongue, and a superior mode of dressing it. When taken young they soon grow familiar, but they are not generally found to thrive in the domesticated state. The European flamingo (*P. roseus*) is abundant in marshy regions of Spain and southern France, and is found as far south as Cape Colony, and as far east as Lake Baikal. In northwestern India it may be seen in flocks numbering tens of thousands. Another very similar species (*P. minor*), but of less size and with the chin feathered, is found from Madagascar around the whole circuit of the shores of the Indian Ocean. Three

other species are known in South America, [illegible] of the central Andes, the largest of the family, *P.* [illegible], of southern Peru and [illegible], and *P.* [illegible] of the region south of [illegible], which has greenish cheeks. In addition to the various ornithologies, the reader may consult an article by H. A. Blake, 'Nineteenth Century' (December 1887); Chapman and Buck, 'Wild Spain' (1893); and F. M. Chapman, 'Bird Lore' (1902).

Flaminian (flā-min'i-an) **Way,** the northern road which led from ancient Rome. It was constructed by Gaius Flaminius the elder in 220 B.C. during his censorship, and led from Rome to Ariminum (Rimini) on the Adriatic, 222 miles. Remains of it are yet extant in various places.

Flamininus, Titus Quintius, tī'tus kwin'shi-us flam-ĭ-nī'nus, Roman general: b. about 230 B.C.; d. about 175. Elected consul in 198, he undertook the conduct of the war against Philip II. of Macedon. By pretending that his object was to remove from Greece the Macedonian yoke, he detached many of the Greek states from Philip, and defeated him at Cynoscephalae (197) in Thessaly. By the treaty soon after concluded Philip surrendered all the Greek towns which he possessed in Europe and Asia, and paid a heavy contribution to the Romans. At the Isthmian games in 196 Flamininus proclaimed, to the great joy of the assembled Greeks, the freedom of those states which had been subdued by Macedon. In 195 he diminished the power of the tyrant Nabis of Sparta, after which he occupied himself in restoring internal peace and prosperity to Greece.

Flaminius, Gaius, ka'yus flā-min'i-us, Roman general: d. 23 June 217 B.C. He was tribune of the people in 232, consul in 223 and 217, and censor in 220. As tribune he carried against the opposition of the senate an agrarian law. In his first consulship he with his colleague attacked the Gauls beyond the Po, and was defeated. The senate then recalled the consuls, but Flaminius resisted the order by refusing to open the letter, and obtained a victory over the Insubrians. A triumph was refused him on his return, but he was rewarded with demonstrations of popular favor. The circus Flaminius and via Flaminia were the monuments of his censorship. In his second consulship he marched against Hannibal, and rashly giving battle, was slain near Lake Thrasymenus.

Flammarion, Camille, kā-mēl flā-mä-rē-ôn, French writer on astronomy: b. Montigny-le-Roi (Haute-Marne), 26 Feb. 1842. In 1858 he entered the Paris observatory as pupil, being transferred in 1862 to the Bureau des Longitudes, where he remained till 1866. Although still a youth, he had already published the first of his many works, namely: 'La Pluralité des Mondes habités' (1862; 30th ed. 1892); 'Les Mondes imaginaires et les Mondes réels' (1865; 21st ed. 1892); and 'Les Merveilles Célestes' (1865; 7th ed. 1881). For five years from about 1868 he made a study of the upper regions of the atmosphere during several balloon ascents. In 1882 he founded the monthly magazine 'L'Astronomie,' and in 1887 started the French Astronomical Society. M. Flammarion has gained considerable fame for original researches in astronomy, especially in connection with double and multiple stars, colors of stars, [illegible], and the proper motion of the stars; but is much better known for his excellent, well-written and accurate popular hand-books. Among his other works are: 'Études et Lectures sur l'Astronomie' (1867–80); 'Dieu dans la Nature' (1867; 22d ed. 1892); 'Lumen' (1872; 4th ed. 1890); 'Voyages en Ballon' (1870; 20th ed. 1889); 'Vie de Copernic' (1872); 'L'Atmosphère' (1872); 'Histoire du Ciel' (1873); 'Petite Astronomie' (1877); 'Les Terres du Ciel' (1877); 'François Arago' (1879); 'Astronomie Populaire' (1880); 'Les Etoiles et les Curiosités du Ciel' (1881); 'Le Monde avant la Création de l'Homme' (1886); 'Les Tremblements de Terre' (1886); 'Uranie' (1880); 'Qu'est-ce que le Ciel' (1891); 'La Planète Mars et ses Conditions d'Habitabilité' (1893). Several books have been translated into English.

Flam'steed, John, English astronomer: b. Denby, near Derby, 10 Aug. 1646; d. Greenwich 31 Dec. 1719. He began his mathematical and astronomical studies at an early age, and in 1675 took orders in the Established Church. He still continued his astronomical observations, and was in constant correspondence with scientific men. He found the astronomical tables of the day to contain large errors, and was anxious to make more detailed and accurate observations. This having come to the knowledge of Charles II., he was appointed astronomical observer to the king, and carried on his observations at the Queen's House at Greenwich, until the observatory was built for him in 1676. Here he passed the remainder of his life amidst his astronomical labors, which are considered as the foundation of modern practical astronomy. He was so ill supported that he had to teach for his own support, and erect instruments at his own expense. In 1684 he was presented with a small living, and his father dying in the same year, he was enabled to provide some needful apparatus at his own expense, which, on his death, was claimed by the government as public property.

Flan'ders, Henry, American lawyer: b. Sullivan County, N. H., 13 Feb. 1826. He studied law and since 1850 has practised his profession in Philadelphia. He has published: 'Maritime Law' (1852); 'The Law of Shipping' (1853); 'Lives of the United States Chief Justices' (1855–8); 'An Exposition of the Constitution of the United States' (1869); 'Law of Fire Insurance'; 'Adventures of a Virginian.'

Flanders (French, *Flandre;* German and Flemish, *Flandern;* Dutch, *Vlaanderen*), a former country or district of Europe, now included in Holland, Belgium, and France. It stretched from the Schelde, below Fort Lillo, west along the Hond, or West Schelde, and west-southwest along the German Ocean to the entrance of the Straits of Dover, near Gravelines, and was bounded east by the duchy of Brabant, south by Hainaut, and west by the French provinces of Artois and Picardy. The origin of the name is unknown. It occurs for the first time, but in a very restricted sense, in the 7th century. The erection of the territory into a county took place in the 9th century, and was made by Philip the Bold, king of France, in favor of his son-in-law, Baldwin, of the Iron Arm. It afterward passed to the united houses of Spain and Austria, and ultimately to the latter, but

FLAMINGO (*Phœnicopterus antiquorum*).

From a Photograph provided by the American Museum of Natural History.

underwent considerable curtailment by the conquests of the French in the west, when part of it became French Flanders, and is now included in departments Nord and Ardennes; and by the conquests of the Dutch in the north, who succeeded in including the most northerly portion of it in the province of Zeeland. The remainder still retains its ancient name, and forms the modern provinces of East and West Flanders, in Belgium (q.v.).

Flanders, East (Fr. *Flandre Orientale*), a province of Belgium, bounded north by Holland, east by the provinces of Antwerp and Brabant, south by Hainaut, and west by West Flanders; length, north to south, 34 miles; central breadth, east to west, 32 miles; area, 1,158 square miles. The surface forms an extensive plain, sloping gently eastward. It wholly belongs to the basin of the Schelde, which by itself, its tributaries, and canals connected with them, furnishes ample water communication. Its soil, partly of a sandy and partly of a clayey nature, is so industriously and skilfully cultivated that it has the appearance of a vast garden, and presents one of the richest rural landscapes which anywhere exists. The principal crops are wheat and flax, but almost all the plants which can be grown under the same latitude are cultivated with success. There are no forests properly so called, but owing to the general practice of planting hedge-row trees, there is no want of wood. In general, however, it consists of poplar and other soft-wood trees, and makes only indifferent timber. There are no minerals of any value, but manufactures have made great progress, and all the ordinary, as well as the fine tissues of wool, cotton, and flax, are well and largely made. There are also numerous tanneries, breweries, distilleries, soap-works, roperies, sugar and salt refineries, etc. The trade includes, in addition to these articles, flax, hops, and oil. For administrative purposes the province is divided into six arrondissements — Gand, or Ghent, the capital; Alost, Audenarde, Termonde, St. Nicolas, and Eecloo. Pop. (1901) 1,029,971.

Flanders, West (Fr. *Flandre Occidentale*), a province of Belgium, bounded north and northwest by the German Ocean, west-southwest and south by France, southeast by the province of Hainaut, east by East Flanders, and northeast by Holland; greatest length, north-northeast to south-southwest, 54 miles; greatest breadth, 48 miles; area, 1,249 square miles. The surface is generally flat, but a few low hills occur in the south and east, and a range of sand hills or downs lines the greater part of the coast. The most important crops are flax, both abundant in quantity and excellent in quality; oats, barley, hops, oil-seeds, tobacco, madder, and chicory. The cattle, of all sorts, are of excellent breeds; and fish, poultry, and game abound. The most important branch of industry is linen, ordinary and damask. Great quantities of lace also are made, and there are numerous breweries, distilleries, tanneries, dye-works, oil-works, soap-works, salt and sugar refineries, etc. The province is divided into eight arrondissements — Bruges (the capital), Courtrai, Ypres, Furnes, Thielt, Roulers, Ostend, and Dixmude. Pop. (1901) 805,236.

Flandin, Eugène Napoléon, nä-pō-lā-ôṅ ē-jen flāṅ-dăṅ, Italian painter and archæologist: b. Naples, Italy, 15 Aug. 1809; d. Tours, France, 1876. He published: ‘Etudes sur la Sculpture Perse’ (1842); ‘Etudes sur la Perse moderne’ (1842); ‘Relation du voyage in Perse’ (1843). In 1843–5 he traveled with Botta through the country of the Tigris, and illustrated his fellow traveler's ‘Monuments de Ninive,’ with drawings of the sculptures of Khorsabad. He finally made a full artistic exposition of Oriental life in his elaborately illustrated work, ‘L'Orient’ (1856); and also wrote ‘Histoire de chevaliers de Rhodes’ (1854).

Flan'drau, Charles Macomb, American writer of fiction: b. Minnesota 1870. He is the author of ‘Harvard Episodes’; ‘The Diary of a Freshman.’

Flan'drians, or **Flemings,** a subdivision of the Mennonite Anabaptist sect. They arose in the 16th century, and were rigid in their procedure. In 1630 A.D. the majority of them entered into a union, confirmed in 1649, with their more moderate brethren, who were often called Waterlanders.

Flandrin, Jean Hippolyte, zhoṅ ē-pō-lēt flăṅ-drăṅ, French historical and portrait painter: b. Lyons 23 May 1809; d. Rome, Italy, 21 March 1864. He worked under Ingres, and from him he imbibed that love of severe and definite form and that classical feeling which he used for his own ends in his religious painting. In 1832 he won the Prix de Rome by his ‘Recognition of Theseus’; and before his five years' residence in Italy was completed he had produced his ‘St. Clair Healing the Blind,’ now in the cathedral of Nantes. Henceforward he was mainly occupied with decorative monumental work, though he also executed many admirable portraits. In 1842 he began his great frescoes of ‘Christ Entering Jerusalem,’ and ‘Christ Going up to Calvary,’ in the sanctuary of the Church of St. Germain-des-Près, Paris, deeply impressive works, which already entitled their painter to rank as the greatest religious painter of the century. The choir of the same church he adorned (1846–8) with figures of the Saints and the Virtues. He also decorated the Church of St. Paul at Nimes (1847–9), the Church of St. Martin d'Ainay at Lyons (1855), and painted the frieze of St. Vincent de Paul, in Paris, with a noble series of saints and martyrs. In 1855 he began his last great work in the nave of St. Germain-des-Près, consisting of subjects from the Old and New Testaments, of which some were left uncompleted at his death, at Rome, 21 March 1864. His ‘Lettres et Pensées,’ with a memoir and a catalogue of his works, were issued 1865. See ‘Lives,’ by Poncet (1864); ‘Montrard’ (1876).

Flandrin, Jean Paul, zhoṅ pōl, French painter: b. Lyons 8 May 1811; brother of the portrait and historical painter Hippolyte Flandrin (q.v.), and a landscape painter whose compositions are of an ideal character and represent a survival of the classical school of Poussin and Claude.

Flan'nan or **Flan'nen Islands,** or **The Seven Hunters,** a group of small rocky islands in Scotland, in the Outer Hebrides, included in the county of Ross and Cromarty, about 15 miles west-northwest of Gallon Head. They are frequented by large numbers of sea-birds, and sheep used to be pastured on some of

them. There is a lighthouse of recent erection, standing at a height of [illegible] feet, the structure itself being [illegible] feet high, with a light visible [illegible] miles.

Flannel, a woolen fabric of more or less loose texture and various degrees of fineness, much used as an article of clothing both in hot and cold countries, and for outer as well as inner garments, being very commonly worn next the skin. Flannel made in Wales from the wool of the native mountain sheep has the highest reputation.

Flannel-mouth, a local name for the great Missouri catfish (*Ameiurus lacustris*). (See Catfish.) Another fish, one of the suckers (*Catostomus latipinnis*) is so called in the neighborhood of the Rio Colorado.

Flannen Islands. See FLANNAN ISLANDS.

Flash, Henry Lynden, American author: b. Cincinnati, Ohio, 20 Jan. 1835. He served during the Civil War as volunteer aide on the staffs of the Confederate Gens. Hardee and Wheeler; and later edited the 'Telegraph' and 'Confederate' in Macon, Ga. He was the author of 'Poems,' and of many popular ballads which appeared during the Civil War.

Flashlight, Electric. See FOG SIGNALS.

Flat Foot, or Pes Planus, a very common deformity of the foot due to a loss of the natural arch. A strong ligament holds the os calcis and astragalus in such a position that an arch is formed by the bones of the foot and the weight of the body is transmitted through that arch. There is a congenital variety that is said to be due to lack of the normal fatty pad in the hollow of the new born infant's foot. During the first five years of life this fatty pad takes the place of the bony arch and if the pad be lacking the arch does not develop. The acquired variety affects those suddenly called upon to stand for long hours upon the feet. A very large number of nurses and soldiers and policemen suffer more or less with this deformity in their early months of training. Rickets, knock-knees, sprains and badly set fractures of the leg may give rise to flattening of the arch.

The bones are not changed from their normal shape except in the very young, but their relation to each other is altered. There is also a stretching of the extensor tendons of the foot and the muscles and fascia of the sole. Besides the flattening of the foot there is a more or less marked turning out of the toes and a tendency to walk on the inner side of the foot. This gait becomes quite characteristic.

In the acute cases particularly there is apt to be severe pain in the spring ligament, the inner malleolus or the ball of the great toe. Because of this, the affection is very commonly thought to be rheumatism, gout, or disease of the bone.

The normal marking of the sole of the foot is an impression of the heel, a narrow margin of the outside of the foot and a broad line made by the ball of the foot. When the arch becomes weakened there is a gradual increase of the outer margin until almost the whole foot makes its impression. This simple test is of great value.

Congenital flat foot may be greatly improved if discovered in time by manipulative massage, bandaging and the use of supports until the bony arch is formed. Acute cases of flat foot in adults sometimes require rest for a time. Properly made shoes without braces frequently suffice to prevent a return of the trouble. Others require the constant use of felt or well-adjusted steel springs in the shoes. Exercises of the extensors of the foot, massage and electricity are of value.

The bad cases of deformity that cannot be corrected require operation under an anæsthetic, the joints being forcibly freed and kept in normal position by plaster cast for a period and then kept up by a support.

Flat'bush, New York, formerly a town in Kings County, Long Island, but since 1900, a part of the borough of Brooklyn, New York. Before being incorporated in the city Flatbush had a population of 15,620. The locality is of considerable historic interest, having been the scene of a part of the battle of Long Island, 27 Aug. 1776.

Flatfish, a fish of the *Heteromomata*, including the families *Pleuronectidæ* and *Soleidæ*, which are characterized by their greatly compressed form, distorted skulls and the habit of lying and moving on the side. They are somewhat related to the cod family, and inhabit the seas of all parts of the world, more than 500 species, classified in some 55 genera, being known to ichthyologists. All are oval or elliptical in outline, very thin and flexible, and habitually rest, half covered, or move sidewise along sandy sea-bottoms, some species near shore, or even ascending rivers, others only in deep water. They are carnivorous, taking as food mainly mollusks, worms, sand-dollars and the like, found in such places, for the crushing of whose shells they are provided with strong teeth, chiefly developed on the inferior side of the mouth. The flatness of these fishes is not a broadening laterally but a compression of the body whereby they become high and thin in a dorso-ventral direction, lie over on one side (usually the left), and have the head permanently twisted to the side uppermost in their customary position. This, however, comes about only with age. The very young flatfish are born in the normal shape of fishes, and swim in the ordinary vertical position, but soon begin to assume the adult peculiarities. This tendency causes profound changes in structure. The skull gradually becomes so distorted that its facial part is twisted at right angles to the plane of the cranial part, and both eyes, set close together, look upward, so that the fish has a seeing and a blind side. In order to get into this position the eye of the under side is rotated around, or in some species right through the young skull, when the fry is only an inch or so in length and the bones not yet ossified. The curious condition of the dorsal fin in the flatfish is nevertheless a greater mark of distinction. The external ethmoid bone belonging to the blind side is much enlarged, and sends back a process outside the eye belonging to that side to meet another process from the cranial region of the skull. Thus, says Cunningham, the eye which has migrated is enclosed in a complete bony orbit, while the other (lower) eye is merely bounded on its outer side by the jaw muscles. It is on this bony bridge entirely foreign to the anatomy of an ordinary fish that the dorsal fin is supported, and is able to extend from the tail clear to the snout, not passing between the eyes,

but separating the hidden from the exposed side. Similarly the ventral and anal fins form a continuous growth along the ventral keel, defining there the upper side from the lower. The lesser forward fins, like the mouth, are usually asymmetrical. They are able to swim well when they please, and sometimes appear at the surface, progressing with a curious sideways undulatory movement very graceful. This is a dangerous excursion, however, and flatfish as a rule cling to the bottom, trusting to be overlooked because of their close resemblance to the sand or mud.

The young flounder or other species is brown on both sides alike; but when it turns on one side and lies flat, the under side becomes nearly white while the upper assumes the color of the bottom upon which the fish habitually rests. This is an excellent example of protective resemblance. (See COLORATION, PROTECTIVE); and that it arises from the habits of the fish and is the effect of persistently keeping the under side in shadow, is plain from the fact, demonstrated by experiment, that when flatfish are confined in aquaria with glass bottoms, through which light is reflected upon the under side, color will develop there. Some flatfish are spotted, increasing their likeness to a pebbly bottom. All these circumstances make it evident that flatfishes originated from symmetrical ancestors related to those of the cod, but what were the inducing causes of the extraordinary changes that have characterized their evolution are not plain. Little help is derivable from palæontology for fossil flatfishes are extremely rare, the oldest known being a sole-like form from the Upper Eocene of southern Europe.

The group includes two families, the flounders (*Pleuronectidæ*) and the soles (*Soleidæ*). Jordan subdivides the former into three sections, namely *Hippoglossinæ*, halibut tribe; *Pleuronectinæ*, flounder tribe; and *Psettinæ*, turbot tribe. The soles are a small family distinguished by the hidden, adnate character of the gill-cover, the small, much twisted eyes and mouth, and the absence of teeth. The whole group yields excellent flesh, and furnishes some of the most important food-fishes of commerce as well as several regarded as especial delicacies. They are treated of at length in Goode's 'Fishery Industries,' Sec. I (1884); and in Jordan and Evermann's 'Fishes of North and Middle America' (1898). See FLOUNDER; FLUKE; HALIBUT; PLAICE; SOLE; TONGUE-FISH; TURBOT; WINDOWPANE.

Flathe, Heinrich Theodor, hīn'riн tā'ō-dōr flä'tě, German historian: b. Tanneberg, near Nossen, Germany, 1 June 1827. He attended the Fürstenschule in Meissen, studied philology and history in Leipsic and in 1867 was appointed teacher in the Fürstenschule at Meissen. His main achievement was the revision and rearrangement of F. W. Bottiger's 'Geschichte des Kurstaats und Königreichs Sachsen' (1867), which he transformed into a new work, for he not merely added new details, but rewrote much of the main argument. He has also among other works written 'Allegemeine Weltgeschichte' (1883).

Flathead, or (properly) **Salish Indians,** a tribe of Indians with uncompressed skulls, as distinguished from the «peaked-heads» who did compress their skulls, and who gave the others the name of Flatheads. These Flatheads are a superior tribe, originally dwelling around the Flathead Lake and River in northwestern Montana; much respected by the traders and explorers as at once very brave against their enemies (chiefly the Blackfeet) and honorably requiting friendly treatment. The famous Flathead mission, the most successful in the Northwest, was established among them in 1841 by the Jesuit missionary P. J. De Smet. They are now located on the Jocko reservation in their old territory, confederated with the Pend d'Oreilles and joined with the Kootenais, the whole numbering 1,280.

Flather, John Joseph, American mechanical engineer: b. Philadelphia, Pa., 9 June 1862. He was graduated from the Sheffield Scientific School of Yale, and after several years' experience in American and foreign machine shops was instructor in mechanical engineering at Lehigh University 1888–91; professor of the same at Purdue University 1891–8; and he has filled a similar post at the University of Minnesota from 1898. He has published: 'Treatise on Steam Boilers' (1889); 'Rope Driving' (1892); 'Dynamometers and the Measurement of Power' (1900).

Flat'tery, Cape. See CAPE FLATTERY.

Flat'ulence. See INDIGESTION.

Flatworms, worm-like animals of the phylum *Platyhelminthes*; especially those of the order *Turbellaria*, characterized by oval outline and decided flatness of body. See *Classification* in article ANATOMY; also PLANARIAN WORMS.

Flaubert, Gustave, güs-täv flō-bãr, French novelist: b. Rouen, France, 12 Dec. 1821; d. Rouen 8 May 1880. His greatest novel was his first, 'Madame Bovary' (1857). He next wrote a historical novel, 'Salammbô,' the scene laid in the most flourishing period of Carthage — a splendid description of ancient Punic life, but having lively interest as a story; 'The History of a Young Man' (1869), like 'Madame Bovary,' a pessimistic picture of social life; 'The Temptation of St. Anthony' (1874), a piece of imaginative writing dealing with philosophical problems; and 'Three Stories' (1877), which had a favorable reception. The posthumous novel, 'Bouvard and Pécuchet' (1881) is a satire on humanity in general. His comedy, 'The Candidate' (1874), failed on the stage. See Tarver, 'Gustave Flaubert' (1895); Faquet, 'Flaubert' (1899).

Flav'el, John, English Nonconformist: b. Bromsgrove, Worcestershire, about 1630; d. Exeter 29 June 1691. He was graduated at Oxford University, inducted into the rectory of Dartmouth, Devonshire, in 1656, but dispossessed and ejected for nonconformity in 1662. During the remainder of an active ministry he preached from house to house and wrote devotional works, which were long popular, and among which are: 'Husbandry Spiritualized' (1669); 'Divine Conduct' (1678); 'The Touchstone of Sincerity' (1697); 'The Soul of Man' (1698); etc.

Flavian Cæsars, flā'vi an sē'zarz, the Roman emperor Vespasian and his sons and successors, Titus and Domitian, who were of the house of Flavius.

Flav'in, a yellow or orange dyestuff. American flavin is got from quercitron bark, and proved to be the same as quercitrin.

Flax (*Linum usitatissimum*). The use of flax has a greater antiquity than any other commercial fibre. It was cultivated and manufactured by the Swiss lake dwellers in the Stone Age of Europe, well preserved specimens of straw, fibre, yarn, and cloth being preserved in the museums. This ancient flax, however, was from another species, *Linum angustifolium*. The Egyptians possessed and used flax thousands of years ago, and the Chaldæans and Babylonians carried its use to the highest state of textile development. Three thousand years ago the Phœnicians extended the culture, and the Greeks and Romans made it a household industry, and it became the aristocratic fibre. It is claimed that the ancient Mexicans knew of both flax and hemp, and its culture in this country goes back to the earliest date of our civilization.

A bast fibre, it may be considered, next to cotton, the most valuable and universally employed textile in the whole range of vegetable fibres. While the plant can be grown in nearly every portion of the temperate world, it is produced commercially in Great Britain and Ireland, Denmark, Sweden, Belgium, Holland, France, Germany, Russia, Austria, Spain and Portugal, portions of Africa and Asia, Japan and the Australian colonies. It thrives in Canada, the United States, and Mexico and in some of the South American countries. Good flax has been grown as far north as Alaska, and the flax of Archangel is famous.

Its cultivation was brought to this country by the American colonists, the records showing that considerable quantities were grown in eastern Massachusetts as early as 1630. Its growth was early extended to other States, though for the most part it was a household rather than commercial industry. In the fifties of the last century three quarters of a million pounds of flax were produced in the United States, Vermont, Connecticut, New York, and New Jersey leading in the culture. With the increased use of cotton fine flax culture steadily declined, and while, as late as 1869, 13,000 tons of flax were produced, a very small proportion was fine line, the bulk being mere tow for the bagging factories. A year or two later, when jute was admitted free of duty, the industry collapsed. At the present time we are growing flax to the extent of a million acres annually, but for the seed, for linseed-oil manufacture, and not for the fibre. The straw, which is rough and coarse, is largely thrown away, although in recent years attempts are being made to use the rough product for paper.

Good commercial fibre could be grown in many localities, notably in Michigan, Wisconsin, Minnesota, Oregon, and Washington. In a series of government experiments, conducted by the writer in the Puget Sound region of Washington, flax-straw was produced from which was hackled out a fibre valued by experts at $500 per ton. Very little line flax is produced at the present time, however, our commercial supply coming largely from Russia, Holland, Belgium, and Ireland; a little comes from Italy and Canada. Much of the "Irish flax" is grown in Belgium and sent to Ireland for preparation.

Nearly every country producing commercial flax has established grades and marks save the United States and Canada. In portions of Russia the grades bear the names of the districts where grown. The grades of Archangel flax are known by the terms first, second, or third crown, etc., and first Zabrack, second Zabrack, while Riga flax is graded from the standard K as HK, PK, HPK, HSPK, etc. Holland flax is graded by roman numerals or by double numerals, as $\frac{\text{II}}{\text{IV}}$ $\frac{\text{I}}{\text{V}}$ VI, VII, etc., Belgian flax also by numerals except Friesland flax, which is lettered, as D, E, Ex, F, Fxx, and so on to Gxxx. French flax is known by the districts where produced and Irish flax by the counties where the flax is grown (see 'Descriptive Catalogue Useful Fibre Plants of the World,' p. 222). Our importations of all kinds of raw and hackled flax last year amounted to 8,466 tons, worth $2,227,141.

The culture of flax requires a deep, well-tilled soil, in high state of fertility, such as moist, deep, strong loams upon upland; a wet soil is disastrous and clays are therefore avoided; and a soil filled with the seeds of weeds is equally fatal to flax culture. The land must be deeply plowed and reduced to fine tilth by harrowing and rolling. In the preparation of the soil, especially in Europe, a systematic rotation of crops is practised, flax occupying the same land not oftener than once in 5 or 10 years. Imported Riga seed gives the best results, although Belgian Riga (Belgian seed produced from one sowing of Riga seed) gives a fine fibre. The common seed of the oil-mills should never be used for fibre culture. When flax is grown for the production of seed alone, to be sold to the oil-mills, the ground is seeded at the rate of two to three pecks to the acre. For fibre culture one and a half to three bushels is the proper quantity per acre.

After the seed has vegetated and is about two inches high the weeding begins, for no fine flax can be produced if the crop is choked with weeds. Flax is harvested by pulling the straw out of the ground roots and all, the straw being laid in handfuls to dry, and afterward made into bundles, which are stacked in the field. Practice varies, however, in different countries as to the handling before the retting period. In Flanders the greatest care is given to drying and storing, in order to keep the flax clean and bright for the final process of retting.

There are three methods of soaking or retting the straw: Dew retting is the simplest and the least careful, the straw being spread over the field like hay, to be retted by the dew, and by the action of the elements. Pool retting is practised by immersing the straw in pools of stagnant water, the softest water giving the best results. The pools are dug in the ground for the purpose, though a great deal of the Irish flax is retted in "bog holes." Retting in running water is the third method, this form of retting being practised in Belgium; the famous Courtrai flax is retted in the sluggish and murky waters of the river Lys, the straw, in bundles, being placed in large crates and weighted with paving stones until the crates sink sufficiently to fully cover the flax. The flax of Courtrai, retted in the Lys, is the finest flax in the world. It is very light in color, clean,

and even, and shows a superior tensile strength. The flax is given two immersions, the straw being taken from the crates and carefully dried before the second immersion.

The first operation in cleaning or extracting the fibre is to pass the straw through a breaker, which loosens the woody portions of the stem, and reduces them to fragments, to facilitate the next operation, the scutching, which whips out the «chive» and all waste matters and leaves the pure flax fibre. In former times the scutching was done by hand, though now machinery is generally used. The scutched flax is subsequently hackled or dressed by repeated combings, which removes the short and broken or tangled fibre, these combings producing tow. Each hackling adds to the quality of the fibre, and of course to the cost. Flax is usually imported in the scutched form, the hackled flax known as «dressed line.» The cheaper grades of flax come from Canada and Russia, the medium and finer grades from Holland, Belgium, and Ireland. The product is used in the United States for threads, twine, and crash, as no fine linen is woven in America. Mexico produces some good flax, and there are linen mills in Mexico city which produce fair grades of fabric. For the details of flax culture and manufacture, consult 'Special Reports' (Nos. 1, 4, and 10), office of Fibre Investigations of the Department of Agriculture; 'Spinning the Threads,' by A. R. Turner, Jr., in Jubilee number of 'New York Dry Goods Economist,' and 'Etudes sur La Culture le Rouissage et el Teillage du Lin,' by Alfred Renouard. See CORDAGE; CORDAGE INDUSTRIES; FIBRE; LINEN.

CHAS. RICHARDS DODGE,
Commercial Fibre Expert.

Flax'man, John, English sculptor and draughtsman: b. York, England, 6 July 1755; d. London 7 Dec. 1826. From his earliest years he exhibited and cultivated his talent for designing, and was also attracted by the picturesque conceptions of Greek mythology. He began to study at the Royal Academy in 1770, earning for some time a living by making designs for Wedgwood, the potter, and other persons. He went to Italy in 1787, and acquired the highest reputation by three series of designs, the illustrations to Homer, Æschylus, and Dante. He became a member of the Royal Academy 1797, and professor of sculpture there in 1810. The monument to Lord Mansfield in Westminster Abbey, the group of 'Cephalus and Aurora,' 'Psyche,' the group of the 'Archangel Michael and Satan,' are among his best works. He executed many exquisite bassi-relievi, compositions from Scripture subjects, and marked by some special religious sentiment. The monuments to Nelson, Howe, and Reynolds in St. Paul's are by his hand. One of his latest and finest productions is the 'Shield of Achilles.' The sculptures and sketches of Flaxman are now deposited and exhibited in a gallery called the «Flaxman Hall,» at University College, London. His 'Lectures on Sculpture' appeared in 1829, passed through a new edition in 1866.

Flaxseed, the seed of the flax plant (*linum*) largely used for domestic and medicinal purposes, produced in large quantities in the south of Europe, Egypt, parts of Asia and in the United States. (For a detailed description of the plant see FLAX; and for its commercial qualities other than seed, see FIBRE and LINEN.) The seeds of flax are dark brown, glossy, oval oblong, flattened, with acute edges, and pointed at one end. The seed is rich in an oil of such superior drying qualities as render it an indispensable ingredient in paint and varnish, and in the manufacture of linoleum, oilcloth, printer's ink, patent leather and other products and manufactures. The cultivation of the plant for fibre requires harvesting before the seed is fully ripe, which impairs the quality and reduces the quantity of the crop of flaxseed. The cultivation of flax for the seed requires a seeding of 2 or 3 pecks to the acre, and while it yields an increase of seed, the fibre straw is coarser; hence flax must be raised exclusively either for fibre or for seed. European countries cultivate flax for fibre, while the United States, Argentine and British India produce the world's commercial crop of flaxseed.

Introduction in America.— Flax for fibre was introduced in the United States soon after the landing at Plymouth. The seed for which there was obviously a limited domestic demand, gradually developed as an article of commerce. So long ago as 1791 the exports of flaxseed from the United States amounted to 292,460 bushels. In the same year began the manufacture of linseed oil in this country. In 1810 there were 283 linseed oil mills located in 14 States, 171 mills being in the State of Pennsylvania. The total annual output of these mills amounted to 770,583 gallons, representing 300,000 bushels of seed. In 1839 the first cargo of flaxseed ever brought into the United States was imported from Russia, and a few years later ships carrying ice to India brought flaxseed on the return voyages. From 1850 to 1870 India shipped a larger quantity of flaxseed to the United States than was produced in this country. From 1850 to 1860 half the entire crop here was grown in Ohio and Kentucky. The linseed oil mills divided or arranged themselves about 1891 into two groups, eastern and western. The former utilized the India imports of seed, while the western mills used the home product. In 1892 the United States took rank among the surplus flax-producing nations of the world and became an exporter of importance. In 1894 a short crop necessitated the import of 4,000,000 bushels. In 1903 there were 13 mills of large capacity in the Eastern States, 4 in Buffalo, 2 in New York, 3 in Philadelphia and other individual mills at Pittsburg and Allegheny, Pa., and Troy and Amsterdam, N. Y. These combined mills crush annually upward of 12,000,000 bushels of seed.

The Western Crop.— The flaxseed industry has migrated from its original western home in Ohio and Kentucky, State by State, until its present area includes North Dakota, South Dakota, Minnesota, Iowa and Wisconsin (known as the northwestern crop), and in Kansas, Missouri, Nebraska, Oklahoma and Indian Territory (known as the southwestern crop). Up to 1869, Ohio was the leading producing State. In 1879 Illinois produced the largest crop, 1,812,438 bushels. In 1889 North Dakota took the lead with a production of 7,776,610 bushels, and in 1902, out of a total production in the United States of 29,284,880 bushels North Dakota produced 55 per cent or 15,552,000 bushels. There are two varieties of seed produced in the West.

[illegible] of the Southwest yield [illegible] 17 pounds of oil to the bushel, while the [illegible] seed of the Northwest yields [illegible] pounds of oil to the bushel (56 pounds).

[illegible] OF FLAXSEED IN THE UNITED STATES.

[illegible]	1849	1879	1902
	Bushels	Bushels	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible] States	[illegible]	[illegible]	[illegible]
Total	[illegible]	7,170,951	[illegible]84,880

[illegible] OF THE WORLD.

Country	1899	1901
	Bushels	Bushels
United States	19,979,000	[illegible]0,000
[illegible]	[illegible]	16,194,000
[illegible]	8,639,000	[illegible]
[illegible]	[illegible]	13,041,000
[illegible]	735,500	1,131,000
France	345,000	611,000
Other countries	1,511,100	1,910,000
Total	66,347,600	72,241,000

The manufacture of linseed oil in the West has become largely localized in cities on and near the Great Lakes. There were 5 mills in Minneapolis in 1902, 6 in Chicago, 2 at Toledo, and 1 each at Cleveland, Milwaukee, South Bend, Ind., and Redwing, Minn. In the northwestern States of Iowa, North and South Dakota, there are but 3 mills, the bulk of all the western crop going to Chicago. Flaxseed in its

[illegible] with pigments and gums and used as paint and varnish. The remainder is utilized in [illegible]ng linoleum, oilcloth, printer's ink, water-[illegible] not made of rubber, enamel for [illegible] few medicinal [illegible]. The oilcake, used only as a cattle [illegible] an extensive market abroad. It is [illegible] by European stockraisers, but little appreciated in America. About 80 per cent of the oilcake product is exported. Belgium alone bought 148,263,752 pounds in 1901. In the [illegible] year 1901–2 oilcake to the value of $[illegible] was shipped to foreign countries, and the average amount exported for five years prior to 1902 was 488,891,125 pounds. In the manufacture of linseed oil from flaxseed two processes are used, one known as the "old" or hydraulic press process, and the other as the "new" or naphtha process. The old process is in use generally throughout the United States, the new process being represented in 1902 by a single mill in Chicago. In December 1902 there were 40 linseed oil mills in operation in the United States. They contained 750 presses with a crushing capacity, if operated 250 days in the year, of 25,000,000 bushels, with an output of 70,000,000 gallons of oil.

AVERAGE PRICE OF FLAXSEED (PER BUSHEL).

Month	1891	1901	1902
January	1.19¼	1.66½	1.65¼
April	1.20¼	1.61	[illegible]
July	[illegible]	1.84½	1.55
October	.95½	[illegible]	1.19½

[illegible]AGE, PRODUCTION, AND VALUE OF FLAXSEED IN THE UNITED STATES IN 1902.

States and Territories	Acreage	Yield per acre	Production	Price per bushel Dec. 1	Farm value Dec. 1
	Acres	Bushels	Bushels	Cents	Dollars
Wisconsin	41,000	12.1	496,100	120	595,320
Minnesota	667,500	10.4	6,942,000	107	7,427,940
Iowa	97,500	7.9	770,250	105	808,762
Missouri	65,700	5.0	328,500	104	341,640
[illegible]	190,200	6.4	1,217,280	101	1,229,453
Nebraska	14,500	8.0	116,000	113	131,080
South Dakota	427,500	7.5	3,206,250	114	3,655,125
North Dakota	2,160,000	7.2	15,552,000	103	16,018,560
[illegible]	12,500	9.0	112,500	68	76,500
[illegible]	34,500	9.2	317,400	97	307,878
[illegible]	2,300	6.8	15,040	122	19,081
California	1,100	15.0	16,500	105	17,325
Oklahoma	19,800	7.7	152,460	95	144,837
Indian Territory	5,600	7.5	42,000	98	41,160
United States	3,739,700	7.83	29,284,880	105	30,814,661

natural state has no domestic uses on the farm, so that internal commerce involves the entire crop.

Flaxseed Products.— The principal product as understood is linseed oil. The residue after the extraction of the oil is the by-product the oilcake, a valuable cattle food, which, when ground, is known to commerce as linseed oil meal. Out of a crop like that for 1902 (29,000,000 bushels), there could be manufactured over 67,000,000 gallons of oil and upward of 1,000,000,000 pounds of oilcake. Of this vast quantity of oil the foreign demand only amounts to 100,000 gallons a year. [illegible] has many uses and the monopoly of its field is so complete it has no substitutes nor adulterants. Probably 75 per cent of the oil manufactured is com-

The value of the flaxseed crop as compared to the value of other crops raised in the United States in 1902, will be of interest:

Value of flaxseed crop	$30,814,661
Value of rye crop	17,080,793
Value of buckwheat crop	8,654,704
Value of barley crop	61,898,034
Value of tobacco crop	57,503,510

Flea-beetles, small leaf-beetles of the tribe *Halticini,* of the family *Chrysomelidæ,* differing from other forms of this family by their extraordinary leaping power due to the enormously developed hind femora. Many of them are injurious to vegetation from their habit of eating the starting leaves full of holes, causing the drying up and death of the plant; hence certain species are known, as "tobacco flea,"

"potato flea," "cabbage flea," etc. In their larval state some species live on the root system of various weeds, the adults doing the principal damage to useful plants. Some species are also leaf-miners, while a few feed on the upper surface of leaves like the young of common leaf-beetles, but most species feed on both surfaces. One of the best remedies is bordeaux mixture, doubly efficient when mixed with Paris green and administered in the form of a spray. See LEAF-BEETLES.

Flea-hopper, either of two species of injurious minute black bugs of the family *Capsidæ.* The commonest is the garden flea-hopper (*Halticus uhleri*), which feeds and breeds normally on clover, but attacks all garden vegetables, commonly on the under sides of leaves, which it punctures so as to cause the death of the tissue in small irregular white patches. It somewhat resembles a flea-beetle (q.v.), but is remarkable in being dimorphic, a portion of the females having well-developed wings, the remainder being short-winged. The best remedy is kerosene emulsion as an under spray, and the avoidance of planting susceptible crops after the cutting of clover fields. A related species is known as the false flea-hopper (*Agalliastes associatus*).

Flea-louse, one of the jumping plant-lice of the family *Psyllidæ,* familiarly represented by a pest of the pear-tree (q.v.). Some of the species make galls.

Fleabane. See ERIGERON.

Fleas, minute wingless insects with bodies covered by a strong armor of fine scaly plates and mouth-parts formed for sucking. They constitute the order *Siphonaptera* and are related to the *Diptera.* Everyone is familiar with these troublesome parasites of man and domestic animals, but few persons have studied them sufficiently to know the larval and pupal stages, or to recognize the fact that there are many species. Only recently has it been established that the flea most annoying to human beings in America is not the human flea of the Old World (*Pulex irritans*), but the so-called dog-and-cat flea (*Pulex serraticeps*). Both species are of cosmopolitan distribution, but the former is fortunately extremely rare in this country, while the latter is to be found everywhere. Observations conducted by the United States Department of Agriculture have shown that the development of these insects is hastened by a moist or humid atmosphere. The egg stage is very short, th larvæ, which are worm-like, spin cocoons in which the pupal stage is formed in from 7 to 14 days after hatching and the imago appears five days later, showing that in the warmest weather an entire generation may develop in little more than a fortnight. Fleas will develop successfully in any situation where they are not too much disturbed, as in rugs, mats, or in straw or litter on which cats or dogs have slept; and they are also carried from one place to another by rats and mice and other animals. Dr. C. F. Baker ascertained in 1895 that there were 47 valid species of fleas in the United States; and probably this number might be doubled if all of the parasites of our larger animals were known. While many persons are indifferent to the presence of fleas others suffer severely from their attacks. Very many alleged cases of "hives" have been found to be produced by fleas, and epidemics of fleas in restricted areas as, for example, in several neighboring houses, have been traced to the body of an animal which had died near by The fleas desert the dying body of their host, jump on the clothing of any person passing, and are thus carried from house to house. One means of protection against them consists in avoiding carpets, and keeping the floors painted and covered with rugs, which should be frequently moved, swept and aired. Household pets should be kept out of the house during the summer time; in fact, it is better to exclude cats entirely, because they cannot be washed and freed from parasites so readily as dogs. Rats and mice also carry these and other parasites. The best remedy for those who suffer from fleas is to apply ammonia as strong as can be borne and as soon as possible to the bite, which in some persons is followed by an eruption as big as a dime, attended by severe itching. The free use of baking soda would serve nearly the same purpose where ammonia cannot readily be obtained. Consult: Howard & Marlatt, 'Household Insects of the United States,' issued by the Department of Agriculture.

Fleece Golden, in Grecian mythology, the fleece of gold taken from the ram on which Phrixus and Helle escaped from being sacrificed.

Fleece, Order of the Golden, a military order instituted by Philip the Good, Duke of Burgundy, at Bruges, 10 Jan. 1429, on the occasion of his marriage with the Portuguese princess, Isabella. The order now belongs to both Austria and Spain. See GOLDEN FLEECE, ORDER OF.

Fleet, (1) A tidal stream, so called from the swiftness of its current, which flowed by the walls of old London city; the title is also applied to a creek; an inlet or arm of the sea, as North-fleet, etc. (2) Fleet Street, London. derives its name from the Fleet ditch. (3) The Fleet, or Fleet Prison, an historic prison in London, so called from its being situated by the side of the Fleet ditch. In it were confined persons committed by the ecclesiastical courts and the courts of equity, exchequer, and common pleas. It existed from the 12th century until its abolition in 1846. (4) Fleet books, the original records of the marriages celebrated in the Fleet prison, between 1686 and 1754. (5) Fleet marriages, marriages performed clandestinely and without banns or license by the poor chaplains in the Fleet prison, previous to 1754, when they were declared illegal by the Marriage Act.

Fleet'wood, Charles, English soldier: b. Northamptonshire, England; d. Stoke Newington, London, 4 Oct. 1692. He was of good family, studied law, was elected member of Parliament in 1646, and appointed governor of the Isle of Wight in 1649. He was made lieutenant-general of cavalry in Cromwell's army, distinguished himself at the battle of Worcester (1651) and married Bridget, Henry Ireton's widow, the daughter of Cromwell. He was put in command of the troops in Ireland, where he resided as Lord Deputy until 1655. He was appointed general of Richard Cromwell's army 18 Oct. 1659, but on the promotion of Monk in December 1659, he resigned. After the Restoration he retired to obscurity at Stoke Newington.

Fleetwood, George, English parliamentarian: b. in Buckinghamshire, England; d. in America about 1660. He represented his native shire in the Long Parliament (1647). He served the English war against the king, raised a regiment of horse for Cromwell's army and was by the latter raised to the peerage. By the government of Charles II he was condemned to death as a regicide, but on changing his allegiance, the sentence was mitigated to confiscation of his estates, and he emigrated to America.

Fleetwood, or **Brandy Station, Battle of.** Gen. Hooker, suspecting that Gen. Lee was gathering his forces on the upper Rappahannock for a movement northward, and informed that Gen. Stuart's Confederate cavalry was at Culpeper Court House, ordered Gen. Pleasonton, who was at Catlett's Station, to cross the Rappahannock at Beverly and Kelly's Fords, attack Stuart, and ascertain Lee's intentions. Pleasonton had the cavalry divisions of Buford and Gregg, and Hooker sent him two picked provisional infantry brigades of 3,000 men, under Gens. Ames and Russell, making in all, cavalry and infantry, an effective force of 10,900 men. Stuart had five brigades of 10,200 men. At daybreak 9 June 1863 Buford, with his cavalry and one brigade of infantry, crossed at Beverly Ford and encountered one of Stuart's brigades, under command of Gen. Sam Jones, and a severe contest ensued, in which the 8th New York cavalry, Col. B. F. Davis, was routed and its commander killed. A charge of the 8th Illinois cavalry drove Jones back two miles, where he joined Stuart and the two brigades of Wade Hampton and W. H. F. Lee. Meantime Gregg, with his cavalry division and an infantry brigade, crossed the river at Kelly's Ford, and pushing back Robertson's brigade, approached Fleetwood Hill from the east, as Buford moved on Brandy Station from the northwest. Fleetwood Hill is a few hundred yards north of Brandy Station, and a hard hand-to-hand struggle ensued at both points, with varying success. Buford held his own near Brandy Station, but Gregg, at Fleetwood Hill, was finally compelled to withdraw, leaving three of his guns in the hands of the enemy. Pleasonton, satisfied that a great part of Lee's army was in his front, recrossed the Rappahannock with about 100 prisoners. The Union loss was 484 killed and wounded and 382 missing. The Confederate loss was 485, of whom 301 were killed or wounded. This engagement marks the beginning of the Gettysburg campaign. Consult: 'Official Records,' Vol. XXVII.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. III.

E. A. Carman.

Fleischer, Heinrich Leberecht, hīn'riн lā'be-reнt flī'sher, German Orientalist: b. Schandau, Saxony, 21 Feb. 1801; d. Leipsic 10 Feb. 1888. He was professor of Oriental languages at the University of Leipsic 1836–88. Beside editing Ali's 'Hundred Sayings' (1837), and other works, he wrote a 'Critical Dissertation on Habicht's Glossary to the First Four Volumes of the Thousand and One Nights' (1836): 'Grammar of the Modern Persian Languages' (1875); 'Kleinere Schriften' (1885–8).

Fleming, George. See Fletcher, Julia Constance.

Flem'ing, John Ambrose, English electrical engineer: b. Lancaster, England, 1849. He was educated at the Royal College of Chemistry and St. John's College, Cambridge, and has been associated for many years with the progress of electrical science. He has published: 'Short Lectures to Electrical Artisans' (1885); 'Treatise on the Alternate Current Transformer' (1889–92): 'Electric Lamps and Electric Lighting' (1894); 'Magnets and Electric Currents' (1897); 'Waves and Ripples in Water, Air, and Ether' (1902); etc.

Fleming, May Agnes Early (Mrs.), Canadian story-writer: b. New Brunswick 1840; d. 1880. She was a prolific author of romances, mostly sensational, among them being: 'Guy Earlscourt's Wife'; 'Lost for a Woman'; 'Pride and Passion.'

Fleming, or **Flemming, Paul,** powl, German lyric poet: b. Hartenstein, Saxony, 5 Oct. 1609; d. Hamburg 2 April 1640. As an attaché of an embassy to Russia and Persia, he had an opportunity (1635–9) of studying many peoples. His 'German Poems,' which appeared in 1642, has been often republished.

Fleming, Richard, English prelate: b. Yorkshire about 1360; d. 1431. At first a supporter of Wiclif's doctrines he subsequently, when bishop of Lincoln, became staunchly orthodox and is remembered as the prelate who dug up and burned the body of Wiclif and cast the ashes into the Swift. He planned a college at Oxford to be a bulwark against heresy, but the present Lincoln College was, however, not founded till after the bishop's death.

Fleming, Sir **Sandford,** Canadian engineer: b. Kirkcaldy, Fifeshire, Scotland, 7 Jan. 1827. He went to Canada in 1845 where he constructed the Inter-Colonial Railway through Nova Scotia, New Brunswick and Quebec. He was engineer in chief of the Canadian Pacific Railway 1871–80, and has published: 'The Inter-Colonial: a History, 1832–76'; 'England and Canada'; 'Time and its Notation'; etc. He was knighted in 1897.

Fleming, William Hansell, American Shakespearian scholar: b. Philadelphia, Pa., 23 Aug. 1844. He was educated at Princeton University and has published: 'How to Study Shakespeare' (1897–9), and edited the 'Bankside Shakespeare.'

Flem'ingsburg, Ky., a town and county-seat in Fleming County, on the Covington, F. & A. R.R. Pop. (1900) 1,711.

Flem'ington, a town and county-seat of Hunterdon County, N. J., on the Pennsylvania, the Lehigh Valley, and the Central Railroad of New Jersey, 50 miles west of New York. Pop. (1900) 2,145.

Flemish Art. See Flemish School.

Flemish Bond, in bricklaying, a particular mode of disposing bricks in a wall, so as to tie and break joints. It consists of a header and stretcher alternately.

Flemish Brick, European brick used for paving; 72 will pave a square yard. They are of a yellowish color, and harder than the ordinary bricks.

Flemish Language and Literature. *Vlämisch* or *Duytsch*, the Low German vernacular

spoken by the Vlamingen or Flemings inhabiting the Belgian provinces of East and West Flanders, parts of Holland and the French department of Nord, is akin to the Frisian and to the Hollandish or Dutch which is its younger branch. The latter differs from Flemish in having been reformed and simplified, while Flemish retains the greater part of the archaic features of its 16th century spelling, pronunciation, and words and forms of speech of French and Spanish origin. Since Belgium became an independent kingdom in 1830, a strong desire has been manifested to foster Flemish traditions and to cultivate and promote its language and literature; before that date its history is identified with that of Dutch language and literature. (See HOLLAND.) Among early Flemish literature is the 'Spiegel historical' (historic mirror) of Jacob van Maerlant (1235–1300), a translation of 'Boece' or 'Boethius' by Jacob Velt of Bruges in the 15th century, and the 'Hive of the Catholic Church,' by Philip van Marnix (1569). The modern movement to rehabilitate the vernacular was largely due to the efforts of Jan Frans Willem who before the separation of Belgium from Holland had strenuously advocated its use as a literary language. With the able co-operation of such authors as Van Ryswyck, Ledeganck, Rense, Van Duyse, Blieck, Serrure, David Conscience and others, the movement made great progress, received official support, and was crowned with success in 1886 when the Koninklije Vlaamsche Akademie (Royal Flemish Academy) was founded and the use of Flemish, as well as French, was adopted as the legal and official language of the kingdom. Prominent amid modern Flemish literature is the verse of Ledeganck: 'De drie Zustersteden,' 'De Hut in 't Wowd,' etc.; of Ryswyck, 'Antigonus,' 'Eppenstein,' and 'Oorspronkelikje Verhalen'; of Van Beers, 'Begga,' 'Levensbeelder.' and 'Gevoel en Leven.' Among works of fiction are Hendrick Conscience's 'Artevelde'; Delcroix's 'Geld of Liefde' and 'Philippine van Vlaanderen'; Sleeckx's 'In 't Schipperskwatier' and 'Dirk Meyer'; and Sneiders' 'De gasthuisnon.' Other well-known novelists are Bergmann, Madame Courtmans, and the two poetesses, Rosalie and Virginie Loveling, poets also including Dantzenberg, De Cort, and Van Droogerbroeck. Representative drama is Sleeckx's 'Meester en Knecht,' and 'Zannekin.' Consult: Willems, 'Sur la langue et la littérature neerlandaises, par rapport aux provinces méridionales des Pays-Bas' (1818); Vercoullie, 'Spraakleer van het Westvlaamsch' (1894); Hamelius, 'Histoire politique et littéraire du mouvement flamand' (1894).

Flemish School, a school of painting which originated in Flanders in the early part of the 15th century, with the invention, or at least the first practice, of painting in oil. It has been generally attributed to Jan Van Eyck, who was accustomed to varnish his distemper pictures with a composition of oils. In course of practice he came to mix his colors with oil instead of water, which rendered them brilliant without the trouble of varnishing. From this and subsequent experiments arose the art of painting in oil. The chief early masters of the school were Jan Van Eyck and his brother and sister, Hubert and Margarete, Matsys, Mabuse, Memling, Weyden, and Moro; to the second period belong Rubens, VanDyck, Snyders, Jordaens and the younger Teniers.

Flensburg, flens'boorg, Prussia, a town in the province of Schleswig-Holstein, 20 miles from the town of Schleswig. It was a place of importance as early as the 12th century, but subsequently suffered much from wars and conflagrations. It is again prosperous, and is now the most important town in Schleswig. The industrial establishments include ship-building yards, sugar-refineries, tobacco-factories, soap-works, foundries, breweries, distilleries, etc. In 1866 it fell to Prussia, along with the duchy of Schleswig-Holstein. Pop. (1901) 48,992.

Flesh (or muscle) is composed of the proteids, myosin, musclin, myoglobulin, and myo-albumin, together with varying amounts of fats, salts, and nitrogenous extractive substances. Of the three classes of foodstuffs needed in the human economy, meat supplies most of the proteid and fat, while the vegetable kingdom supplies the carbohydrates. The proteids are more properly the tissue-building elements, while the fats and carbohydrates are more readily oxidizable, and supply the body with energy. Proteids must be taken as such, since the human economy cannot cause conversion of the other sorts of food into proteids. The minimum of these various substances for the proper preservation of life has not been positively determined, but approximately the average healthy man requires 100 grams of fat, 400 grams of carbohydrate, and 100 grams of proteid per diem. The necessary amount of proteid material can be obtained from the vegetable kingdom, and there is no doubt that some systems are better suited for this diet; but to the large majority of individuals a mixed diet, containing a certain amount of meat, is more readily taken care of. The meat proteids are usually more quickly and completely digested.

The nitrogenous extractive substances, ceratine, the xanthin bases, and the like, are also of value to the system because of their power of exciting gastric secretions and stimulating circulation. The various meat extracts contain a large proportion of these substances, and most of them have little else. An overabundance of meat very frequently causes a nervous, irritable condition. This is less true of the so-called white meats, a difference not to be explained on the ground that the white meats contain less of the extractives, since the opposite is the case. As a general rule the diet of the well-to-do in America is entirely too high in food-value, but particularly in the amount of albuminous foods. These constant errors find their expression in the well-nigh universal complaint of dyspepsia and so-called uric-acid disturbances. Such intoxications are almost sure to follow if more animal food is taken than can be digested and absorbed. Putrefaction of the unabsorbed food takes place, with generation of toxic substances and absorption of them into the general circulation.

Flesh-fly, any of a large group of showy flies (family *Sarcophagidæ*), the more familiar and typical members of which breed in decaying flesh. Some, however, pass their larval stages in dung, or decaying vegetables, or are parasitic in the wounds and sores of animals and man. Most of them look like large house-flies, sometimes bright with metallic blue or green, or gray

[illegible] with which these flies find and [illegible] their living [illegible] is regarded as an evidence that they are under the control of an impulse of a chemical character rather than merely following a sense of smell.

Fleshly School, The. See DECADENTS.

Fletch'er, Alice Cunningham, American ethnologist: b. Boston, Mass., 1845. She is the originator of the scheme by which loans are made to Indians in order that they may buy lands and build houses. She is now employed in the management of the Peabody Museum of American Archæology and Ethnology, and is the author of 'Indian Story and Song from North America' (1900).

Fletcher, Andrew, of Saltoun, Scottish political writer and patriot: b. Saltoun, Haddingtonshire, 1653; d. London, September 1716. Having distinguished himself in opposition to the court he deemed it prudent to retire to Holland; and on his non-appearance to a summons from the lords in council he was outlawed. In 1685 he joined the enterprise of the Duke of Monmouth. He subsequently joined the Scottish refugees in Holland, and when the revolution of 1688 took place returned to England with William of Orange, resumed possession of his estate, and became a member of the convention for settling the new government in Scotland. In 1698 he printed 'A Discourse on Government in Relation to Militias'; and also, 'Two Discourses Concerning the Affairs of Scotland.' His tracts and some of his speeches appeared in one volume, entitled: 'The Political Works of Andrew Fletcher, Esq.' (1737). Consult Omond, 'Fletcher of Saltoun' (1897).

Fletcher, Benjamin, English colonial governor. He was appointed by William and Mary in 1692, after serving during the war in the Low Countries, as well as in Ireland. When William Penn was for a time deprived of his proprietary rights he acted as governor in Pennsylvania (1693–4). He was at last forced to resign from his post in New York, and many charges were made against him. Consult: Wilson, 'Memorial History of the City of New York' (1892).

Fletcher, Giles, English poet: b. Watford, Hertfordshire, about 1549; d. London March 1611. He was ambassador to Russia in 1588, but his description of that country, 'Of the Russe Common Wealth,' appearing in 1591, was suppressed. It was reprinted for the Hakluyt Society 1856. He also wrote 'Licia: Poems of Love' (1593).

Fletcher, Giles, English poet: b. about 1588; d. 1623. He was a son of Giles Fletcher the elder, and wrote the poem, 'Christ's Victory' (1610). A new edition appeared in 1824.

Fletcher, James Cooley, American clergyman and author: b. Indianapolis, Ind., 1823. Between 1851 and 1865 he traveled widely as a missionary in Brazil, and was at one time secretary to the United States legation at Rio de Janeiro. In 1869–73 he was consul at Oporto, Portugal, later was a missionary in Naples, Italy, and from 1877 was resident at Indianapolis. His 'Brazil and the Brazilians,' early editions of which contain the name of D. P. Kidder as associate author, was long the authoritative English work on the subject.

Fletcher, John. See BEAUMONT, FRANCIS, AND FLETCHER, JOHN.

Fletcher, Joseph Smith, English journalist and novelist: b. Halifax, Yorkshire, 1863. He has written extensively for newspapers under the pseudonym "A SON OF THE SOIL," as well as novels and collections of short stories which have been very popular, and several of which have been widely read in the United States. His published books include: 'Anima Christi' (1884); 'When Charles the First was King' (1892); 'Poems' (1892); 'The Quarry Farm' (1893); 'The Wonderful Wapentake' (1894); 'Where Highways Cross' (1895); 'Mistress Spitfire' (1896); 'Ballads of Revolt' (1896); 'Life in Arcadia' (1896); 'At the Gate of the Fold' (1896); 'God's Failures' (1897); 'The Making of Matthias' (1897); 'The Builders' (1897); 'The Paths of the Prudent' (1899); 'From the Broad Acres' (1899); 'Morrison's Machine' (1900); 'The Harvesters' (1900); 'A Picturesque History of Yorkshire' (1899–1900); 'The Three Days' Terror'; 'The Golden Spur' (1901); 'Bonds of Steel'; 'The Investigators' (1902); 'In the Days of Drake'; 'At the Blue Bell Inn.'

Fletcher, Julia Constance (pseudonym "GEORGE FLEMING"), American novelist; b. Rio Janeiro, Brazil, 1858. She is a daughter of James Cooley Fletcher (q.v.). She has resided for years in Italy and in London. Her novels are: 'Kismet' (1877); 'Mirage' (1878); 'The Head of the Medusa' (1880); 'Andromeda' (1885); 'The Truth about Clement Ker' (1889); 'For Plain Women Only' (1895); and 'Little Stories about Women' (1897). She has also written the plays: 'Mrs. Lessingham' (1894); 'A Man and His Wife' (1897); 'The Canary' (1899); 'The Fantasticks' (1900).

Fletcher, Lazarus, English mineralogist: b. Salford, England, 3 March 1854. He was educated at Balliol College, Oxford, and has been keeper of minerals in the British Museum from 1880. He has published: 'Introduction to the Study of Meteorites' (1881); 'Introduction to the Study of Minerals' (1884); 'The Optical Indicatrix' (1892); 'Introduction to the Study of Rocks' (1895).

Fletcher, Phineas, English poet: b. Cranbrook, Kent, April 1582; d. about 1650. He was a son of Giles Fletcher the elder and a cousin of John Fletcher (q.v.). He was the author of 'Sicilides,' a pastoral drama (1614); 'The Purple Island and Piscatory Eclogues' (1633). 'The Purple Island' is an allegorical description of man, founded upon an allegory in the ninth canto of the second book of the 'Faerie Queene.' It is composed in the Spenserian manner, and is not without passages of strong fancy and beauty of description. In the first five cantos, however, the reader loses the poet in

the anatomist — a character but little adapted to the handling of poetry. When, however, he steps from the physical to the intellectual man, he not only attracts, but secures attention by a profusion of images, many of which are distinguished by much boldness of conception and brilliancy of coloring. The 'Piscatory Eclogues' have considerable sweetness of versification, and much descriptive elegance. Milton was indebted to both Phineas and his brother Giles, different passages of the 'Paradise Lost' and 'Paradise Regained.'

Fletcher, Robert, American surgeon: b. Bristol, England, 1823. He was graduated at the Royal College of Surgeons 1841; came to the United States, and was surgeon of an Ohio regiment during the Civil War. He afterward became principal assistant librarian of the surgeon-general's office at Washington, D. C., and professor of medical jurisprudence in the Columbian University. He has published: 'Paul Broca and the French School of Anthropology' (1882); 'Human Proportion in Art and Anthropometry' (1883); 'The New School of Criminal Anthropology' (1891); 'Scopelism' (1897).

Fletcher, Robert Howe, American soldier and author: b. Cincinnati, Ohio, 21 July 1850. He entered the United States Naval Academy at 17, and at graduation was transferred to the army where he served on the Indian frontier and in California till 1886. Since 1898 he has been curator of the Mark Hopkins Institute of Art at San Francisco. He has published: 'A Blind Bargain'; 'The Johnstown Stage'; 'Marjorie and Her Papa.'

Fletcher, William Isaac, American librarian: b. Burlington, Vt., 28 April 1844. He has been librarian of Amherst College from 1883 and is the author of 'Public Libraries in America' (1895); and was joint editor of 'Poole's Index to Periodical Literature.' He has also edited continuations of the latter (1882–1900); the 'A. L. A. Index to General Literature' (1893); and the 'Co-operative Index to Periodicals' (1883–91).

Fleur-de-lis, flėr-dė-lē, an heraldic emblem probably derived from the iris-plant. Some of the great families of France (most of whom are now extinct) bore the emblem on their shields from the very commencement of the practice of blazoning, and a large number of families in Germany, Sweden, Switzerland, and other parts of Europe have borne the fleurs-de-lis on their coats of arms from the 12th century. The great popularity of this emblem in France dates from the 13th century. The royal coat of arms of France consisted of three golden lilies on a blue ground, with the device, '*Lilia neque nent neque laborant.*' The shield of France was anciently, in heraldic language, *semé de fleurs-de-lis*, that is, bore this emblem scattered over the shield. It is commonly believed that it was Charles V. (1364–80) who reduced the number to three; but this is disproved by the fact that two seals have been preserved, the one belonging to Philip the Fair (1285–1314), the other belonging to Philip of Valois (1328–50), both of which bear three fleurs-de-lis; and the town library of Rouen contains a collection of charts relating to the celebrated abbey of Savigny, to one of which, bearing the date 1212, a seal is attached, which is still in a state of perfect preservation, representing three fleurs-de-lis exactly similar to those used on the shield of France. Hence it appears that the use of this emblem in a triple form is much more ancient than is usually thought. See HERALDRY.

Fleurus, flė-rüs, a town in Belgium, province of Hainaut, seven miles northeast of Charleroi. It has manufactures of coarse woolens and flax, with some tanneries and salt-works, and a trade in agricultural produce. In the vicinity, in August 1622, the Spaniards under Gonzales defeated the army commanded by Ernst von Mansfeld; 1 July 1690, the French under Marshal Luxembourg defeated the Germans under Prince Waldeck; and 26 June 1794, the French republican forces under Marshal Jourdan defeated the Austrian army. The battle of Ligny, also, is sometimes known as the battle of Fleurus, Ligny being only about two miles from Fleurus. Pop. (1901) 6,264.

Fleury, André, Hercule de, äṅ-drā ãr-cül dė flė-rē, a cardinal and prime minister of France under Louis XV.: b. Lodève, Languedoc, France, in 1653; d. 29 Jan. 1743. Coming to court, he won general favor by his pleasing person and fine understanding; became bishop of Fréjus; and, through the interest of Madame Maintenon, was appointed instructor to Louis XV. In 1726 he was made cardinal, placed at the head of the ministry, and from his 73d to his 90th year he administered the affairs of his country with great success.

Fleury, Claude, clōd, French Church historian: b. Paris, France, 6 Dec. 1640; d. there 14 July 1723. His learning and unaffected simplicity made him a notable figure at the court of Louis XIV., and later at that of Louis XV., whose confessor he became. An 'Ecclesiastical History' (1691–1720) forms his claim to enduring renown; the work coming down to 1414, at which point a later writer has attempted, though not sympathetically, to round out the master's performance. 'A History of French Law' (1674) and a 'Historical Catechism' (1679) are less important achievements.

Fleury, Maurice de, mō-rēs dė, French physician: b. Bordeaux 1860. He studied under his father at Bordeaux, and practised in the hospitals there and at Paris. His specialties are nervous complaints and the physical and intellectual training of children, so as to produce a sound mind in a sound body. He has published many valuable contributions to the subjects of his special study. Such are: 'Contribution à l'étude de l'hysterie senile' (1890); 'Traitement rationnel de la neurasthénie' (1894); 'Pathogénie de l'épuisement nerveux' (1806); 'Introduction à la médecine de l'esprit' (1897); 'L'âme du criminel' (1899); and 'Le corps et l'âme de l'enfant' (1899).

Fleury-Husson, Jules. See CHAMPFLEURY.

Flexibility, in physics, the property which all bodies possess to a greater or less degree, and which is evinced in their disposition to yield or change their form in a direction at right angles to their length, through their own weight or by means of any pressure or strain applied to them. Pieces of the same material differ from each other in the degree of flexibility they exhibit in proportion to their length and thickness. See PHYSICS.

Flexner, Simon, American path[illegible]: b. [illegible] M. D. in 1889. He then became a post-graduate student at [illegible]ently pursued his pathological studies at the Uni[illegible] and has [illegible] year last named. He [illegible] Chemical [illegible] and pathologist at [illegible] Hospital and Philadelphia Hospital [illegible] 1903. His ability was further recog[illegible] of the R[illegible] of Research in New York, [illegible] study of the [illegible] Among his publications are: '[illegible] Albumin Intoxication'; '[illegible]'; 'The Bacillus Pyogenes [illegible]'; '[illegible] of Dysentery'; '[illegible] Infections'; 'Experimental Pancreatitis'; 'The Nature of Snake Venoms,' and many other papers and monographs relating to [illegible]al and pathological subjects.

Flexure, in mechanics, is a species of strain in which a solid body is distorted so that certain of its original planes become converted into cylindrical or conical surfaces. The term is [illegible]nly used in connection with beams, where it signifies the elastic yield of the beam under the influence of its load. When a beam is supported at both ends and loaded in the middle, it sags in such a manner that its originally [illegible] longitudinal fibres become curved into approximately circular arcs. The radius of [illegible] very large, of course, in practical [illegible], where the beams are composed of [illegible]. In a beam that is supported and [illegible] above, the upper fibres of the beam are in compression, and the lower ones in [illegible]. The compressive strains in the upper parts, and the tensile strains in the lower parts, decrease toward the middle of the beam, and somewhere about the middle there is a sur[illegible] "neutral surface," or "neutral [illegible], on which there is neither tension nor compression. The flexure of such a beam is measured by the depression of its centre under the [illegible] load; this depression being [illegible]l to the product of the load by the cube of the length of the beam between supports, and inversely proportional to the continued product of the horizontal thickness of the beam, multiplied by the cube of its vertical [illegible] the value of Young's modu[illegible] which the beam is made. (See [illegible]; [illegible] OF MATERIALS.) Consult also, [illegible], '[illegible]ful Rules and Ta[illegible].'

Flick, Lawrence F., American pathologist: b. [illegible], Pa., 10 Aug. 18[illegible]. He [illegible] Benedictine College near [illegible] graduated in medicine at Jefferson Medical College, Philadelphia, in 1879. He [illegible] specialty and early in [illegible] a movement for the prevention of this disease. In June 1888, he read a paper upon the contagiousness of phthisis [illegible] of the State of Pennsylvania, showing that houses which had been occupied by consumptives gave the disease to subsequent occupants, and that the malady was essentially a contact disease. He [illegible]ntly published many monographs upon this topic, and 1890 started a movement for the [illegible]lishment of consumption hospitals which culminated in the founding of the Rush Hospital [illegible] of the chest. In 1892 he founded the Pennsylvania Society for the Prevention of Tuberculosis, of which he was president for some years. In 1895 he helped to found the Free Hospital for Poor Consumptives and was elected its president. In 1903 he was entrusted with the establishment of the Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis and was appointed its medical director.

Flick'el, Paul, powl, German artist: b. Berlin 8 April 1852. He studied three years in the Art School at Weimar, and in 1874 went to Düsseldorf and in a year began his career as a landscape painter. He traveled for the sake of studying art in Germany and Austria. In 1877 he continued his wandering in Italy and on the spot painted many pictures, such as 'The View of Naples from Capo di Monte'; 'Garden at Monte Carlo'; 'Fountain of the Villa Borghese,' scenes in which he showed a skilful management of bright sunlight effect, and complete mastery in handling the luxuriant vegetation of the south. His pictures of mountain forest scenery in Austria attracted notice and his 'Beech Forest,' which was based on studies made near Prerau, Moravia, gained for him the "Great Gold Medal" at the Berlin exhibition of 1880.

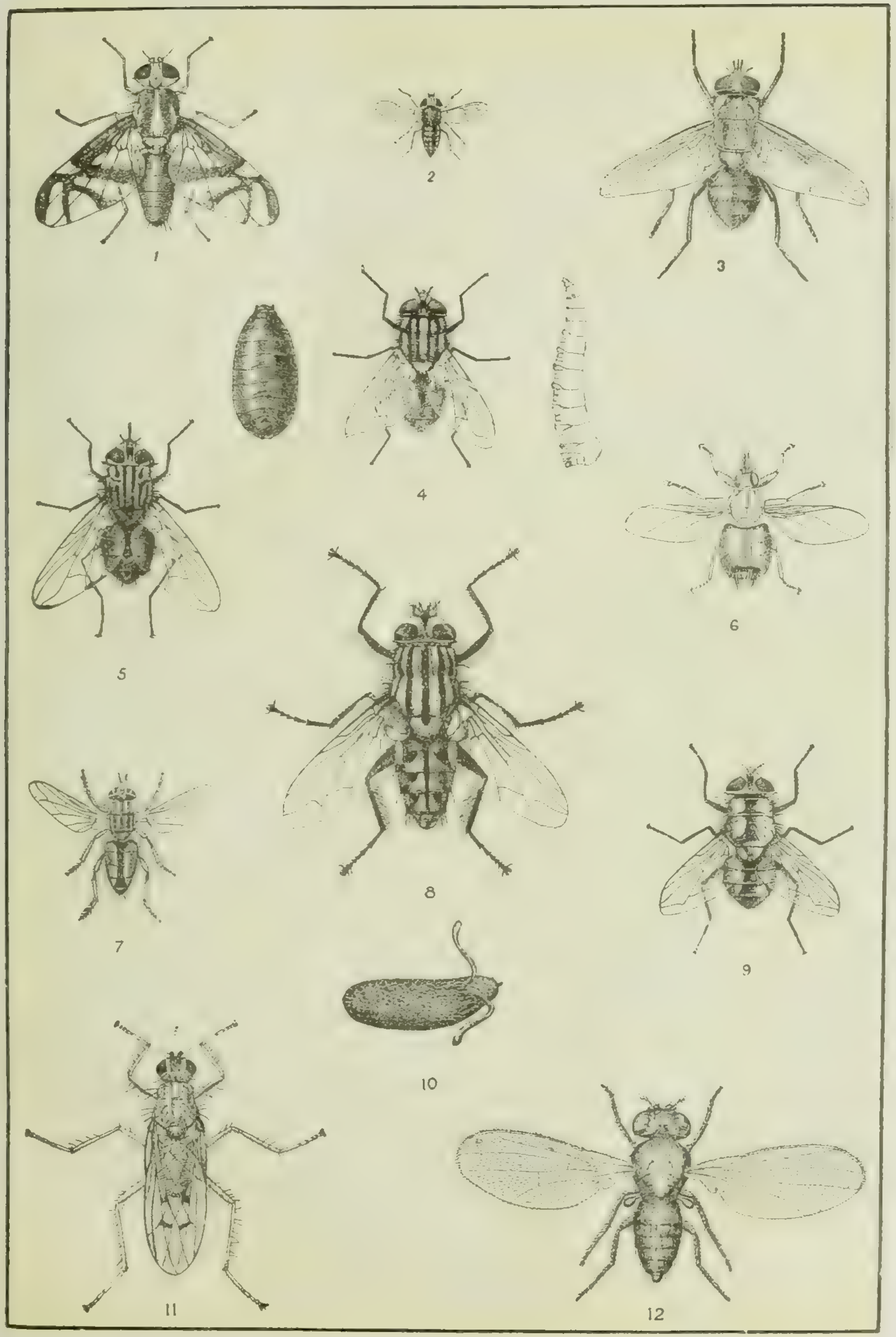
Flicker, one of the many local names of the North American golden-winged woodpecker (*Colaptes auratus*). This name, derived from one of the bird's characteristic calls, is coming into far more general use than formerly. A description of the bird will be found under WOODPECKER.

Flick'inger, Daniel Kumler, American bishop of the denomination of United Brethren: b. Sevenmile, Ohio, 25 May 1824. In 1857-85 he was corresponding secretary of the United Brethren Missionary Society, in 1885 became foreign missionary bishop, and in that capacity made 12 journeys in Africa. His publications, besides a volume of sermons, include: 'Off-Hand Sketches in Africa'; 'Ethiopia'; 'The Church's Marching Orders'; 'Our Missionary Work.'

Fliedner, Theodor, tā'ō-dōr flēd'nĕr, German Lutheran clergyman: b. Eppstein, Nassau, Germany, 21 Jan. 1800; d. Kaiserswerth 4 Oct. 1864. He became pastor in Kaiserswerth 1822. He gradually amassed in this poor parish an endowment fund for a church, school and poorhouse. In 1833 he founded an asylum for released female convicts, and in 1835 an infant school, at Düsseldorf, the earliest in Germany; a similar institution was organized by him at Kaiserswerth, the year following. In the same year he founded the Deaconesses' association, which was his greatest and most notable work. Among his writings, which are principally devotional and educational, may be mentioned 'Das Buch der Martyrer.'

Flies, two-winged insects of the order *Diptera* (q.v.), whose larvæ are legless, soft, and cruciform, and are termed "maggots." The

HOUSE, STABLE, AND GARDEN FLIES.



1. Apple-worm Fly. 2. Orange-belted Gadfly. 3. Horn-fly. 4. Common House-fly, with maggot and puparium. 5. Stable-fly. 6. Forest-fly or Bird-tick. 7. Meat-fly. 8. American Flesh-fly. 9. Green-bottle Flesh-fly. 10. Egg of Pomace-fly. 11. Dung-fly. 12. Pomace-fly.

group is world-wide in its distribution, and probably quite as numerous as either the beetles, or the group of wasps, bees, ants, etc. It is now known to contain about 40,000 species, most of which are incalculably numerous in individuals; so that "swarms" of flies is a proverbial expression. Entomologists believe that 8 or 10 times 40,000 species really exist. This vast abundance is due to the plenitude of their food, and to their fecundity; and it is accompanied by a very high state of organization, so that certain families of flies are held by some students to stand at the head of the insect tribe in specialization of structure. Intellectually, however, they are far behind the *Hymenoptera;* and to this fact, to the small size and unattractive appearance of most specimens (although great brilliance of color is to be found among some families), and to the comparatively uniform and uninteresting nature of their metamorphoses, are to be charged the relatively small amount of study that has been given to the group. The life-history of the ordinary flies is detailed below; but many peculiarities exist in other families of the order. "With some," says Howard, "no eggs are laid, and living larvæ issue from the body of the female. Such flies then become practically viviparous or 'larviparous.' With others, although these are few in number, the development within the body of the female goes even farther, and when the insect emerges from the body of its mother it is already in the pupal condition. Such forms are called 'pupiparous.' . . . Many species — comprising, in fact, whole families — are aquatic or subaquatic in their early stages, and some possess the faculty of living under what appear to be most disadvantageous conditions." Some of the flies of the family *Ephydridæ* (whose eggs or larvæ are eaten by American Indians,— see AHUATLE; KOO-CHAH-BEE) live in the strongly alkaline lakes of the Far West where little else can exist.

Flies are mainly day-flies, and fond of sunshine, but some appear only at night or in the dusk; a section of the tribe does not fly at all, being wingless and parasitic. They live in the most diverse manner; some attack large animals and suck their blood; some prey on smaller insects; some suck honey, and in search of it take part in the cross-fertilization of flowers (see FLOWERS AND INSECTS); and many find their food in decaying animal and vegetable matter. A large number of dipterous larvæ eat refuse or carrion,— whence arise serious evils to mankind,— others feed inside growing vegetables; and some maggots prey, or are parasitic upon, other animals.

A type of the group is found in the house-fly (*Musca domestica*), which represents the great family *Muscidæ*, in which most of the familiar flies about houses and stables are included, and its life-history represents that of its kind generally. Its eggs are laid preferably on horse-manure, but also on human or other excrement, decaying vegetables, etc., and hatch in six or eight hours, producing white maggots. These mature in four or five days, when their skins harden and turn brown, forming a puparium, or case, within which the true pupa forms, and five days later gives birth to a perfected fly. Thus a total life cycle requires in midsummer only about 10 days, and a dozen generations may thus be born in warm climates within a single season. As each fly deposits on the average 120 eggs, and as the maggots of 1,200 house-flies may be sustained by a pound of manure, the possible rapidity of their multiplication is apparent. Most flies live but a few weeks, and toward the end of the season they die with great rapidity, becoming infested with reddish mites, which suck their juices, or with fatal fungous diseases (see FUNGI). In warm houses a few may survive a winter, but as a rule all adult flies die in the fall, and the species survives and recovers in the spring from the eggs or pupa left over winter in the manure-heap or other feeding-place. It is plain that attempts to mitigate the annoyance and danger resulting from many flies may best be directed toward the destruction of their eggs and young. That such destruction is desirable and the duty of society is plain when one considers the vast amount of injury these insects may do. Many sorts attack vegetables and fruit, for example the hessian-fly, which is perhaps the most destructive insect in the United States, the apple-fly, the gall-flies, fruit-midges, potato-scab gnat, and others. Others harm domestic animals, as the bot-flies, sheep-ticks, horn-flies, tsetse, and all the horse-flies, bee-killing robber-flies and bee-flies, black-flies, mosquitoes, and many more. This catalogue of harmfulness (to which can be opposed only the beneficial work done by the tachina-flies which cause the death, by parasitism, of other kinds of injurious insects) becomes of small importance, however, beside the enormous evil flies do in spreading virulent diseases from man to man and place to place. Were this not so it might be true, as formerly alleged, that their services as scavengers, as parasites, and in the cross-fertilization of plants, balanced the damage caused by some, and left something to their credit.

Flies as Carriers of Disease.— Consideration of the habits of house-flies and their relatives will show how prone they are to feed upon excrementitious matter, and to be attracted to any decaying or purulent substance. When this is the product of wounds, sores or diseased bodies it is likely to contain the germs of disease; and these may be sucked into the blood or cling to the body of the insect. If, then, the fly alights upon a human being or a susceptible animal, and punctures the skin with its sucking proboscis (for ordinary flies do not "bite," properly speaking), it is likely to leave in the puncture some of the germs it has fed upon, and so infect the person with the disease to which they give rise. Wounds may thus be inoculated with "blood-poison"; and certain diseases, grouped as "myiasis" may arise from taking into the stomach, in eating spoiled vegetables, minute flies (*Anthomyia*) breeding in them. Even vegetable diseases may be so transmitted, as is the case with the "scab" of potatoes, which, according to Hopkins, is spread from plant to plant by the visits of a fungus-gnat (*Epidapus scabiei*).

That this theoretical transmission of disease actually occurred has been demonstrated since the latter part of the 19th century by observation and experiment. It was first ascertained of certain mosquitoes, whose responsibility for much if not all of the malaria from which men suffer was shown. This may be found more fully treated under Mosquitoes (q.v.), where the agency of these small ubiquitous flies in spread-

ing other diseases is also shown. Dr. Joseph Leidy attributed the spread of gangrene in the hospitals at Washington during the Civil War to the flies; a few years later it was shown that gad-flies which had settled upon the body of cattle affected with anthrax would communicate the disease to healthy kine. In 1888 an Italian investigator showed that flies fed upon a bacillus culture would drop virulent bacilli in their ordure, capable of infecting new cultures; further experiments in India showed that flies fed with a culture of the bacilli of bubonic plague and of Asiatic cholera survived and conveyed the plague to man. An English physician asserted that typhoid fever was spread by insects; and this was abundantly proved during the prevalence of that disease in the military camps during the Spanish-American war of 1898. Flies which have access to the excreta of patients and afterward alight upon food, so infect the food that whoever eats it is in danger of taking ill with the fever. Howard demonstrated that the common house-fly was the principal agent in this transmission. Subsequent investigations showed that the danger of the propagation by flies (and other household insects) was equally great in diphtheria and yellow fever. In another series of cases, as among mosquitoes, the fly acts as intermediary host for disease germs which develop in its blood to the point where they are virulent when introduced into the circulation of man or beast. Such is the case with the African tsetse fly (q.v.), which transmits a greatly dreaded cattle-disease. The purulent ophthalmia, known as "pink-eye," and particularly prevalent in the South, is facilitated by minute gnats of the genus *Hippelates*.

Dr. L. O. Howard, of the United States Department of Agriculture, has given special attention to this matter, and has found that no less than 77 species of flies frequent human excrement and are therefore liable to obtain and carry disease germs. As the innumerable insects themselves are beyond reach, the measures for protection must be preventive. Dr. Howard says that in order to avoid epidemics of typhoid fever it is necessary to abolish the box privy, prevalent in rural and village districts, and substitute earth-closets, where water-closets cannot be installed; to place stable manure in receptacles and treat it with chloride of lime to destroy the maggots, throwing a shovelful over each day's addition. Pantries, dining-rooms and kitchens should be carefully screened to keep out flies; and especial pains taken in summer to keep flies out of sick-rooms. Detailed instructions and the reasons for them are given by Howard in his pamphlet, 'How Insects Affect Health in Rural Districts,' issued as Farmers' Bulletin 155, by the United States Department of Agriculture.

Classification.— The classification of the *Diptera* has proved difficult. An early division was based on the structure of the antennæ: *Nemocera* — those having the antennæ thread-like and with 6 to 30 joints, and *Brachycera*, those with the antenna three-jointed and bristle-like. A later and more widely accepted subdivision was based upon the way the pupa escapes on emergence of the fly: in the *Orthorapha*, the pupæ escape from the larval skin through a T-shaped orifice; in the *Cyclorapha* the pupæ escape through a circular opening at the anterior end. American entomologists, following the special investigations of D. W. Coquillet, now usually divide the order into two sub-orders based upon the character of the mouth-parts, and characterized as follows:

Sub-order Proboscidea.— Antennæ conspicuous, inserted at upper end of the face, sometimes many-jointed, proboscis usually furnished with terminal lips, body rather soft and brittle, legs approximated, wings usually present and frequently furnished with a discal cell; adults oviparous or larviparous, never in all their stages living externally on mammals, birds, or honey-bees.

In this group are placed, in order, the following important families: *Tipulidæ* (crane-flies), *Culicidæ* (mosquitoes), *Cecidomyiidæ* (gall-gnats), *Mycetophilidæ* (fungus-gnats), *Simuliidæ* (black-flies), *Leptidæ* (snipe-flies), *Stratiomyiidæ* (soldier-flies), *Tabanidæ* (horse-flies), *Bombyliidæ* (bee-flies), *Asilidæ* (robber-flies), *Syrphidæ* (syrphus-flies), *Œstridæ* (bot-flies), *Tachinidæ* (tachina-flies), *Sarcophagidæ* (flesh-flies), *Muscidæ* (house-flies), *Anthomyiidæ* (fruit-flies), *Trypetidæ* (fruit-flies), *Ephydridæ* (edible salt-water flies), and *Oscinidæ* (grass-stem flies); besides various less important ones. Each is more particularly described elsewhere in this work.

Sub-order Eproboscidea.— Antennæ usually inconspicuous, commonly inserted near the middle of the sides of the face, and composed of from one to three joints, the apex furnished with a style or bearing several long bristly hairs, proboscis never furnished with terminal lips, body integument tough and leathery, legs on one side of the body usually widely separated from those on the other side, wings, when present, never furnished with a discal cell; adults pupiparous, living externally upon mammals, birds or honey-bees.

This second sub-order comprises only two families, the parasitic bird-ticks (*Hippoboscidæ*) and the bat-ticks (*Nycteribidiidæ*), which owe their vernacular names to their resemblance to true ticks in appearance and habits.

Bibliography.— L. O. Howard's 'Insect Book' (New York 1901) contains the latest and most fully illustrated general account of the flies, and also a large list of books on the subject, especially those relating to systematic description. S. W. Williston has an excellent illustrated account in 'The Standard Natural History,' Vol. II. His 'Manual of American Diptera' (New Haven 1896); Comstock's 'Manual for the Study of Insects' (Ithaca, N. Y., 1895); Packard's 'Half Hours with Insects' and 'Text-Book of Entomology'; and Miall's 'Natural History of Aquatic Insects' (1895), may be consulted with profit.

Flight. Flight, strictly speaking, is progress through the air in any desired direction by an agent or object heavier than the air, as opposed to the floating of an object lighter than the air, such as a balloon. Animals accomplish flight mainly by means of wings, which may be special organs as in the insects, or modified fore legs, as in the case of bats and birds. The wings of insects are always thin membranes supported by a stiffer framework. In bats they consist of extensible membranes stretched over the immensely elongated fingers and joined also to the sides of the body and the hind legs. The wings of birds are composed of long stiffened

REPRESENTATIVE FLIES.

feathers attached to the rudimentary fingers and to the bones of the forearm; the individual feathers overlapping one another so as to form a continuous more or less arched surface. The tail feathers constitute another sail area which plays an important part in flight, while in many bats a continuation of the flight-membrane between the hind legs has much the same function.

Besides these special organs the structure of aërial creatures is modified in many other respects with a view to facilitating flight. Thus the hollow bones of birds are lighter than the solid bones of terrestrial animals and relieve birds of much unnecessary weight; while the general shape of the bird's body and the smooth rounded contour of its feather covering are calculated to give the least possible resistance to the air during flight. Birds are also provided with large distensible air sacs under the skin, the function of which has been a matter of much dispute, but which, as suggested by von Leudenfeld, may aid in shifting the centre of gravity of the body, a matter of the utmost importance to the bird in holding to its course or in turning in flight. The centre of gravity, we may note, is also kept well below the plane of the wings by the distribution of the heavy parts of the body on the pectoral side. So that as the bird flies the heavy breast muscles, which constitute the bulk of its weight, are well down while the wings are attached to the back of the thorax. Thus the body becomes essentially a weight hung directly below an outstretched sail area.

So much for the general structure of flying creatures. Turning now to the principles of flight we have as the main agencies (1) the muscular propulsion on the part of the bird; (2) the support offered to the «sail area» by the air; (3) the force of the wind both in raising and in propelling the bird. Mechanical and physical problems are involved in the study of flight which it will be impossible to consider here, but one or two principles may be mentioned which are of fundamental importance, and the application of which may be seen in all forms of flight. We know that the resistance (that is, support) of the air to a flat surface is greatly increased when the surface is traveling rapidly through the air in its own plane, and it follows that when a bird is once on the wing the buoyancy of the air relative to it is greatly heightened: and having gained a certain momentum it will be possible for the bird to sail some distance without loss of altitude. Again when a flat surface is sailing diagonally through the air the maximum pressure (that is, support) of the air is not under the centre of the surface, but under the forward edge. It is on this principle that we find a tendency to force up the anterior edge of the wings of a sailing bird and in order to counteract it the bird is compelled to shift the centre of gravity of its body farther forward. To do this it may draw the wings back, spread the tail or perhaps extend the head and neck. On the same principle to turn the direction of flight it is merely necessary to flex or raise one wing or one side of the tail. Flight proper may be of two sorts, (1) by flapping the wings, and (2) by soaring. The former is the most familiar and is practised by all birds, while the latter is possible only for birds of large expanse of wing, such as vultures, eagles, gulls, etc.

In taking flight it is very important for the bird to «get a start,» as we say; that is, to acquire some relative velocity, and to accomplish this we often see birds which are about to fly run along the ground for a few steps or flap along the surface of the water, while starting head toward the wind with wings properly spread accomplishes the same result. Rising into still air by flapping is very laborious work and some heavy-bodied birds, as the loons, for instance, are utterly unable to take flight when confined within a small area.

When once in the air and fairly started in flight the wing action is far less laborious than at the start, and the upward stroke is often relative to the body only and not necessarily a muscular effort. When this stroke is active, the individual feathers, as instantaneous photographs show us, are more or less separated to reduce the resistance of the air on the recovery. Most birds mingle flapping and straight sailing in various ways, and when once on the wing flight is mainly a matter of presenting their sail area to the air currents in such a way as to gain the greatest benefit from them.

Soaring is flight in circles with set wings and without any visible muscular action on the part of the bird. In spite of this the bird is able to mount higher and higher in the air, gaining impetus enough on the flight with the wind to carry it above its initial altitude when returning on the other half of the circle against the wind. Many theories have been advanced to explain the «soaring bird,» some of them purely fantastic, but the true solution of the problem seems still to be lacking. Suffice it to say that this method of flight is possible only in the presence of currents of air, and that the unequal velocity of air at different altitudes doubtless has much to do with it.

Aëronauts naturally look to birds for suggestions in artificial flight, and the great superiority which they exhibit over the best flying machine so far constructed may be seen in Prof. Langly's comparison of his aërodrome which has repeatedly flown from a half to three quarters of a mile, with a condor. The machine with a weight of 30 pounds and a supporting area of 54 square feet is driven by an engine of one and a half horsepower, while the bird weighing 17 pounds has a sail area of only 9.85 square feet and a propelling power of but .043 horsepower. Birds vary very much in wing power according to their method of flight; the humming-bird and pigeon being abundantly supplied with wing muscles to maintain their rapid strokes, while the frigate-bird, a notorious «sailer,» is remarkably weak in muscular development. The speed of flying birds also varies greatly. The best flyers of which we have definite record are the carrier pigeons, which travel from 30 to 50 miles an hour, while an albatross, caught and tagged by sailors, was recaptured, according to Lucas, 12 days later, 3,150 miles distant.

Our familiar small birds do not travel at anything like such a rate, but their endurance is very great, as we can realize in view of their migrations, which often reach from the northern United States to equatorial South America, while the small waders travel from one end

of the hemisphere to the other. See MIGRATION.

Flying [illegible] occur among mammals, reptiles and birds. The extinct pterodactyls were [illegible] experts on the wing, and some of them constituted the largest flying animals of which we have any record. Of mammals the bats are the only true fliers, the flying squirrels and lemurs having merely parachute-like expansions of skin on the sides of the body which when the legs are stretched out enable them to sail obliquely downward from the tree tops to the lower branches.

In the flying-fish (q.v.) there is an enormous development of the pectoral fins which simulate wings. Their flight, however, consists only of a short sail through the air on an impetus gained as they leap from the waves with the fins rigidly extended.

Consult: E. J. Marey, 'Vol des Oiseaux' (Paris 1890); Prof. Chas. S. Roy, article 'Flight,' in 'Newton's Dictionary of Birds' (1896); Prof. S. P. Langley, 'The Greatest Flying Creature,' Smithsonian Report 1901.

Flightless Birds. Certain birds are quite unable to fly, or fly very poorly, or use their wings only as paddles or balancers, or in extreme cases have lost not only the use of wings, but the wings themselves have disappeared. Examples of this degeneration will be found treated of in the articles upon APTERYX; DODO; GARE-FOWL; MOA; OSTRICH; PENGUIN; RATITÆ; SOLITAIRE.

Flinch, a card game said to have had its origin in Kalamazoo, Mich., and to have been invented by a man named Flinch. The game is played with a pack of 150 cards, numbered consecutively from 1 to 15, there being 10 cards of each numeral. All are of the same color; there are no hearts, diamonds, clubs or spades, and the court cards, are, of course, also missing. The cards are shuffled, and 10 cards are dealt to each player for his flinch pile, then 5 more to each to play with. Each player must place his flinch stack face up, with only the top card exposed. The other five cards are kept in hand, spread out like a fan to see the numbers, for flinch has not as yet the dignity of indexed-edged cards. The object of the game is to get rid of the flinch pile, and whoever first succeeds wins the game. To this end the flinch pile must be played from whenever possible. When this is not done, the opponent will call "flinch," and the player will have to draw a card from the opponent's flinch pile and place it on the bottom of his own. In case two or more of the opponents call "flinch" at the same time, the negligent player must draw a card from the pack. The game may be played by any number from two to eight. After shuffling, the entire pack is usually stacked up criss-cross into handfuls of five, to facilitate drawing new hands.

Flinck, Govaert, Dutch painter: b. Cleves 25 Jan. 1615; d. Amsterdam 2 Feb. 1660. At Amsterdam, where he took up his permanent residence, he became a pupil of Rembrandt, whose manner and technique he so closely imitated that he comes nearer to the master than any other of his pupils, with the exception of Eeckhout. He was much sought after as a portrait painter, and has also left many religious pictures and a few genres, such as 'The Watchtower,' which is equally Rembrandtesque in subject, conception and treatment.

Flind'ers, Matthew, English navigator: b. Donington, Lincolnshire, England, 10 March 1774; d. London 19 July 1814. He did much toward mapping out the coastline of Australia. In his first voyage of discovery he started in 1795 from Port Jackson, and skirting the southeast coast reached Van Diemen's Land. In a subsequent voyage of discovery, on which he was despatched by the British government with but poor equipment, he sailed along the south coast to Cape Leeuwin, and the bay which now bears his name. He next explored the east coast of Australia, from Port Stephens to Cape Palmentone; threaded the formidable Barrier Reefs, and coasted the Gulf of Carpentaria. Then turning back he made for Europe, by way of Sydney. He was shipwrecked on this voyage and detained by the French in Isle de France for seven years. From the effects of this imprisonment he never recovered. On his arrival home he published 'A History of Terra Australis.' The coast of South Australia was long called after him Flinders Land. His name is still attached to the southernmost county in Eyre Peninsula, and to Flinders Island, off that coast; to the Flinders Range in South Australia, rising near the head of Spencer Gulf, and running north (highest peaks, 3,100 feet); also to a town in Victoria, 61 miles southeast of Melbourne. See Life by Thynne (1896).

Flinders-Petrie, William M. See PETRIE, WILLIAM MATTHEW FLINDERS.

Flindersia (named after Captain Matthew Flinders), a genus of trees of the order *Meliaceæ*, allied to the mahogany, to which, however, it is generally inferior. The trees of this genus are tall, with a correspondingly great diameter, and furnish large quantities of valuable timber. *F. australis*, the Queensland ash, is used in Australia for staves, etc.; *F. oxleyana* is a hardwood tree yielding excellent material for cabinet-work, and also furnishing a yellow dye. The wood of *F. greavesii* is used in house-building, for which it is well adapted by its durability.

Flint, Austin, American physician: b. Petersham, Mass., 30 Oct. 1812; d. New York 13 March 1886. He was graduated at the medical department of Harvard College in 1833. After practising in Northampton, Mass., Boston, and Buffalo, where he established the Buffalo 'Medical Journal' in 1846, he was one of the founders, and for six years a professor, of the Buffalo Medical College. He was a professor in Louisville University 1852-6; professor of pathology in the Long Island College Hospital in 1861-8; president of the New York Academy of Medicine in 1872-5, and of the American Medical Association in 1884. He was the author of numerous text-books, clinical reports and medical papers.

Flint, Austin, American physician, son of the preceding: b. Northampton, Mass., 28 March 1836. He was graduated from the Jefferson Medical College, Philadelphia, 1857, and removing to New York in 1861 became professor of physiology in Bellevue Hospital Medical College, and surgeon general in 1874. He has published 'Text-book of Human Physiology'; 'Physiology of Man'; 'The Source of Muscular

Power'; 'Chemical Examinations of Urine in Disease'; etc.

Flint, Grover (originally **Flint Grover**), American writer: b. New York 27 June 1867. He was graduated at Harvard in 1888 and from 1892-4 served in the United States army as cavalryman. In 1896 he went to Cuba and served with a Cuban insurgent army, and returning to the United States, some months later, married a daughter of John Fiske (q.v.). He served in Cuba in the Spanish-American war and subsequently went to the Philippines as a lieutenant of volunteers. He has published 'Marching With Gomez, With Historical Introduction by John Fiske' (1898).

Flint, Timothy, American author: b. North Reading, Mass., 11 July 1780; d. Salem, Mass., 16 Aug. 1840. He was a Congregational minister during 1812-4; subsequently he devoted himself to editorial work, descriptive writing, and fiction. In these departments his most important work is included in: 'The Geography and History of the Mississippi Valley'; 'Indian Wars in the West'; and 'Francis Berrian'; 'George Mason;' and 'The Shoshone Valley.'

Flint, Weston, American librarian: b. Pike, N. Y., 4 July 1835; d. Washington, D. C., 6 April 1906. He was graduated at Union College in 1860, and at the law department of Columbia University in 1877. He was United States consul to China 1871-4; librarian of the Scientific Library, United States Patent Office, in 1877-87; and was appointed librarian and secretary of the board of trustees of the Public Library in Washington in 1898. His publications include: 'Catalogue of the Library of the United States Patent Office' (1878); 'Catalogue of Additions to the Library of the United States Patent Office, 1878-82'; and 'Statistics of Libraries in the United States, Canada, and Washington' (1893).

Flint, Mich., a city and county-seat of Genesee County, on the Flint River and on the Chicago and Grand T. and the Flint and P. M. R.R.'s; 64 miles northwest of Detroit. Flint has a court-house, the State Institution for the Deaf and Dumb, a private retreat for the insane, a high school, waterworks, gas and electric lights, public library, a national bank, and several daily, weekly, and monthly periodicals. It has a large number of saw-mills, carriage and wagon factories, flour- and woolen-mills, bicycle-works, brewery, etc., and an assessed property valuation of about $13,000,000. Pop. (1901) 13,103.

Flint, or **Flintshire,** North Wales, a maritime county having on the north the Irish Sea and on the east the river Dee and Cheshire, with the county of Denbigh on the west. Its area is 256 square miles, and it is the smallest county in Wales. The low and sandy coast becomes fertile along the estuary of the Dee. A range of hills running parallel to the Dee rises in the highest part to 825 feet. The Carboniferous rocks underlie Flintshire, and the chief minerals are coal, iron, copper, lead, zinc, and limestone. Mining is the principal industry, and there are some manufactures of cotton, pottery, chemicals, etc. The chief towns are Flint, St. Asaph, Mold, Holywell, and Hawarden. Pop. (1901) 81,490.

Flint, Wales, a market town and seaport, in Flintshire, 13 miles southwest of Liverpool. It has a handsome parish church in the Gothic style, erected in 1848. Near the town, on the shore of the estuary, stands the ancient castle of Flint, an object of some historical interest. It was completed by Edward I., and was the prison of Richard II. It has remained in ruins since 1667. Flint is on the Chester and H. R.R. Pop. (1901) 4,624.

Flint, a massive variety of quartz, somewhat resembling chalcedony, but more opaque, and commonly of a gray or smoky-brown color, darker in the interior than on the surface. It occurs abundantly in the United States and in various other parts of the world. In England and France it occurs chiefly in the chalk formations, and a microscopic examination of it often shows the remains of diatoms and other minute organisms, from whose silicious skeletons the silica of the flint was doubtless largely derived. In other cases the flint was probably formed by the replacement of lime by silica held in solution by the ground water. The coloring matter of flint is chiefly carbonaceous matter, with some iron sesquioxide. Flint was used for many ages in the manufacture of stone implements, a use for which it is well adapted by its hardness, and also from the fact that it breaks with a conchoidal fracture, leaving sharp cutting edges. Previous to the invention of matches, flints were greatly used for the production of fire, the flint being struck repeatedly against a piece of steel, from which it detached small particles that were rendered red-hot by the friction. These were caused to fall into a mass of very dry and highly inflammable matter, known as "tinder," which took fire from them as dry grass beside a railroad takes fire from the sparks of passing locomotives. Before the invention of the percussion cap, flints were also used on musket locks, for igniting the powder.

Flint Glass. See Glass.

Flint Implements, tools, weapons, etc., made of silicious or flinty stones; a term particularly denoting implements used by man before the use of metals. See Stone Age.

Flint Mill, (1) In pottery, a mill in which burnt flints, having been previously stamped to reduce them below a certain size, are ground to powder for mixing with clay to form slip for porcelain. The flint-mill is a strong circular pan 10 or 12 feet in diameter, having a bottom of quartz or feldspar blocks, and a runner or runners of hard silicious stone, called chert, lime in any form being inadmissible, as it forms a flux for the other material which would vitrify in the seggars or become blistered by the escape of carbonic acid. (2) In mining, a mode formerly adopted for lighting mines, in which flints studded on the surface of a wheel were made to strike against a steel, the blows producing a quick succession of sparks, which lighted the miner at his work.

Flint River, one of the largest rivers in Georgia, rising near Atlanta and flowing 300 miles to the Gulf. It drains an area of 8,000 square miles.

Flintlock, the old-fashioned lock for firearms, in which the cock held a piece of flint, and came glancing down upon the steel cap of the pan which contained the priming. See Firearms; Musket.

Floating Battery, a vessel strengthened so as to be shot-proof, or as nearly so as possible, and intended for operating in comparatively smooth water, for defending harbors or attacking fortifications. The most notable attempt to make use of floating batteries against maritime fortresses, till the time of the Crimean war, was during the siege of Gibraltar in 1782, when batteries of this description, invented by the Chevalier d'Arçon, were employed at first with considerable effect. On this occasion, however, they turned out in the end a complete failure, being destroyed by the red-hot shot directed against them from the fort. After this failure no more attention was paid to them until Napoleon III suggested the use of floating batteries, protected by iron plates, in attacking the Russian fortresses in the Black Sea and the Baltic. The suggestion was actually carried out, and the floating batteries then constructed proved very effective in 1855, during the operations against Sveaborg and Kinburn, as well as on subsequent occasions.

Floating Bridge. See BRIDGE.

Floating Docks. See DOCKS.

Floating Fern. See *Filicales* (4), under FERNS AND FERN ALLIES.

Floating Gardens. See FLOATING ISLANDS.

Floating Houses, abodes so constructed as to be movable at will upon the surface of a river or other water. Floating houses form whole streets in Bangkok, being anchored in rows and capable of being moved from one position to another. From the depth of water, large vessels of from 200 to 300 tons burden can sail up to this picturesque town and pass alongside the houses of the inhabitants. These floating houses are made of bamboo stems, wicker-work, and palms, with a veranda in front; and they are built on large rafts. See BANGKOK.

Floating Islands, islands formed either by the aggregation of driftwood in rivers and the deposition thereon of soil and vegetable matter, or by the detachment of portions of a river-bank or lake-shore. Tall trees are sometimes seen standing erect on such islands as they are carried down by the river current. Floating islands are sometimes seen 50 or 100 miles distant from the mouth of the large rivers of America, Asia and Africa. Portions of the alluvial soil from river-deltas, held together by the roots of mangroves and other trees, are sometimes detached by hurricanes or typhoons and then swept out to sea; such islands have been met with in the Philippines, in the seas of the East Indies, and in the Pacific. A floating island is mentioned by Herodotus as existing in Egypt. Others were known to Roman writers. Those on Lake Vadimona were, according to the younger Pliny, capable of supporting sheep. Loch Lomond in Scotland long possessed a floating island, which has now, however, disappeared or become attached to one of the stationary islands of the loch. In Ireland large masses of peat float about some of the bogs. In England, in Lake Derwentwater, there is an instance of an island which appears and disappears from time to time in the same spot. Perhaps the most satisfactory of the many theories which have been proposed to account for this phenomenon is that which attributes its rising from the bottom of the lake, where it ordinarily rests, to the permeation of its mass by marsh-gas during hot weather, the upward motion being assisted by the growth of buoyant water-plants on its surface. Between 1696 and 1829, similar islands were observed at irregular intervals, generally, however, after great droughts and violent storms, in Lake Rålang in the Swedish province of Småland. Oceanic floating islands sometimes perform important service in the transportation of vegetable seeds from place to place, also in the distribution of animal species, by carrying insects, land mollusca, and small mammalia, more rarely reptiles. Darwin met with islands floating on Lake Tagua-Cagua in Chile which passed from side to side of the lake and carried cattle and horses as passengers. In Northern India, and on the borders of Tibet, and Persia, floating gardens are often erected by the natives, for the purpose of raising melons, cucumbers, and other similar vegetables and plants, which require a very aqueous soil for their cultivation. These gardens, however, are of a very fragile nature, and rarely exceed a foot in depth of soil, their prime structure being composed of wicker-work, interlaced with reeds and wattles, and covered with matting, over which the earth is placed. In the Vale of Cashmere the lakes contain floating gardens devoted to the same purpose, but these are in reality portions of the marshy ground made to float artificially by cutting through the roots of the reeds and other plants about two feet below the surface. The Chinese, too, devote considerable attention to this style of horticulture, but more by way of ornamentation. Floating gardens, or *chinampas*, also existed in Mexico before the Spanish conquest. Clavigero describes them as formed of wicker-work, the stems of water-plants, and mud, the largest sometimes having on them a tree or a hut. Both flowers and vegetables were grown on them.

Floats. (1) In angling, the quill or cork from which the bait line is suspended, and whose motion indicates the bite of a fish. (2) An inflated bag or pillow to sustain a person in the water. (3) The small piece of ivory on the surface of the mercury in the basin of a barometer. (4) The hollow, metallic ball of a self-acting faucet, which floats on the water in the cistern or boiler. (5) A raft, or collection of timber fastened together for conveyance down a river. (6) In hydraulic engineering, one of the boards or paddles attached to the radial arms of a paddle wheel or water wheel. (7) In machinery, a single-cut file, or one in which the teeth are parallel and unbroken by a second row of crossing teeth. The usual horizontal obliquity of the teeth relatively to the central line of files is 55°, but single-cut files are much less inclined, and the teeth of floats are sometimes square across the face of the file. (8) In plastering, a plasterer's trowel used in spreading or floating the plaster on to a wall or other surface. The long-float is of such a length as to require two men to use it. The hand-float is that in ordinary use. The quirk-float is used in finishing moldings. An angle-float is shaped to fit the angle formed by the walls of a room. (9) In masonry, a polishing-block used in marble working; a runner. (10) In shoe making, the serrated plate used by shoemakers for rasping off the ends of the pegs inside the boot or shoe. (11) In tempering, a contrivance for affording a copious stream of water to the heated

steel surface of an object of large bulk, such as an anvil or die in the process of tempering. The rapid production of steam prevents the constant contact of cold water when the object is merely dipped, as a body of steam intervenes. The dashing stream of water constantly exposes a new body of water to the hot surface, and makes the hardening more complete. (12) Theatrical: A stage name for the footlights, derived from the use of a row of oil-pans, with floating wicks, along the stage-front, previous to the invention of gas.

Float-stone, a variety of opal, or hydrated silica, occurring in concretionary masses of such a porous texture that they float on water. They are of a gray or white color, break with uneven fracture, and sometimes have a hard nucleus of a flinty appearance.

Flodden, flod'n, a village in Northumberland, England, about five miles southeast of Coldstream, near which was fought the celebrated battle in which James IV. of Scotland was defeated by the Earl of Surrey (9 Sept. 1513). See SCOTLAND.

Floe-rat. See SEAL.

Flogging, the infliction of stripes or blows with a whip, lash, or scourge, especially as a judicial punishment. In Britain it long existed as a punishment in the army and navy; but it was totally abolished in the former in 1881, and in the latter it is practically extinct. It was made a punishment for certain violent crimes, such as garrotting, in 1863; and for juvenile offenders in 1847 and 1850. In these cases, however, the number of stripes is limited by law, 50 being the maximum in some instances, 25 in others, and so on. A judge in sentencing a prisoner to flogging must specify the instrument and the number of stripes. In the case of juveniles under 14 years of age the instrument must be a birch rod, and the number of stripes must not exceed 12. The punishment of the knout in Russia and of the bastinado in the East are severe forms of this punishment. In the United States, flogging was discontinued in the navy and on merchant vessels in 1850. In the army, it was abolished 1861. As a means of prison discipline, it has been used till very recently, and its disuse is a subject of debate. For the subject of its use as a legal punishment for certain offenses, see FLAGELLATION; WHIPPING-POST.

Flood, flud, **Henry,** Irish orator and politician: b. near Kilkenny 1732; d. Farmky, county Kilkenny, Ireland, 2 Dec. 1791. He was educated at Trinity College, Dublin, and Christ Church, Oxford, entered the Irish parliament in 1759, and soon became the most prominent and eloquent member of the popular opposition. He was privy councilor for Great Britain as well as for Ireland in 1775, and vice-treasurer for Ireland 1775-81. In 1783 he had a personal dispute in the house with Grattan, when a remarkable display of the power of invective was made on both sides. He afterward became a member of the British Parliament for Winchester and Seaford. His speeches were published in 1787. See Lecky: 'Leaders of Public Opinion in Ireland' (1872).

Flood, Theodore L., American Methodist clergyman: b. Williamsburg, Pa., 20 Feb. 1842. He served in the Federal army in the Civil War, entered the Methodist ministry, and after an active pastorate of 15 years became connected with the Chautauqua movement. He edited the Chautauqua Assembly 'Herald,' which began its monthly issue at Meadville, Pa., in 1877, and became 'The Chautauquan' in 1880. He retired from its editorship and ownership in 1899. He has been active in various denominational and commercial enterprises and was an unsuccessful Republican candidate for Congress in 1892.

Flood Plain, the plain formed by a river in broadening its valley. The first work done by a river is to cut a trench-like valley, this having been cut so deeply that the slope of the river-bed toward the sea so slackens the current of the river that it cannot carry its load of detritus, this detritus is partly dropped. Then the upbuilding of the river channel causes the river current to swing from side to side. In this way first one side, then the other of the valley is attacked by the river. In time of flood the plain of waste thus accumulated may be entirely covered by the swollen river. The flood plain of the Mississippi west of Tennessee is 50 miles wide. See RIVER; VALLEY.

Floods and Inundations are caused by excessive rains, giving rise to an overflow of the rivers; by the bursting of the banks of rivers, lakes, and reservoirs; by the sudden melting of ice and snow; and by irruptions of the sea, produced by high tides, wind-storms driving the sea-water inland, earthquakes, volcanic outbreaks, and the bursting of sea banks. The felling of forest trees throughout extensive tracts of mountainous country also tends to make the rivers which have their origin there swell rapidly after a heavy rainfall; good and complete drainage of land has the same tendency. (For the Noachian flood, see DELUGE.) The subjoined list embraces some of the most disastrous floods and inundations of which we have record.

684 A.D. Japan; 780 sq. m. of Isle of Shikoku covered by sea.
968. Persian Gulf; many cities destroyed and new islands formed by irruption of sea.
1014. Many English seaports destroyed by sea.
1098 or 1100. East of Kent inundated; Goodwin Sands formed.
1100 or 1108. Flanders inundated.
1161 or 1165. Sicily; irruption of sea; thousands drowned.
1170. Holland and Friesland; great flood.
1173. Holland; Zuyder Zee much enlarged.
1219. Nordland, Norway; lake burst; 36,000 people perished.
1228. Friesland; invasion of sea; 100,000 people drowned.
1277. Friesland; the Dollart formed.
1286–7. Holland on both sides of Zuyder Zee inundated in consequence of a storm.
1396. Holland; islands of Texel, Vlieland, and Wieringen separated from mainland, and Marsdiep, the channel between Texel and North Holland, formed.
1421 or 1446. Holland; 72 villages inundated, of which 20 permanently, about 100,000 persons drowned, Biebosch formed east of Dordrecht, and this town separated from mainland.
1521. Holland; 100,000 lives lost by an inundation.
1570. Holland; storm drove in the sea, destroying numerous villages and 20,000 people in Friesland.
1617. Catalonia, Spain; 15,000 perished in floods.
1629. Mexico (city) inundated.
1642. China, at Kaifong; 300,000 drowned.
1646. Holland and Friesland inundated; loss of life, 110,000.
1726. Floods and inundations all over Europe.
1745. Peru; Callao destroyed by irruption of sea caused by earthquakes.
1767. England; irruption of sea on east coast.

[illegible] submerged, and [illegible]
1787–8. India, in Northwestern Provinces and Punjab; [illegible]
[illegible]
[illegible]
1813. [illegible] in Po [illegible]
[illegible]
[illegible] submerged [illegible]
[illegible]
[illegible] banks, [illegible]
[illegible] Belgium to Swit- [illegible]
[illegible] floods did damage to extent [illegible],000.
[illegible] and Iquique nearly destroyed by earthquake wave[illegible]
[illegible] River valley (Mass.) inundated [illegible] a dam; 144 drowned. [illegible] floods in western Pennsylvania, [illegible]
1875. Disastrous floods throughout central Eur[illegible], in [illegible], India, and West Indies.
1876. China floods in northern provinces; in Bengal [illegible] persons perished from inundation of a tidal wave.
1883. Java and Sumatra; parts submerged by volcanic wave. (See Krak[illegible])
1887. China; the Hoang-ho in Ho-nan; millions of lives lost.
1880. Johnstown, Pa.; reservoir burst; 2,209 lives lost.
[illegible] lives lost.
[illegible]; great destruction of property.
[illegible] 27,000 lives lost
[illegible],000 lives lost and 3,000 buildings [illegible]
1903. Kansas City, Mo., and Mississippi River towns; [illegible] of dollars in property destroyed; few lives lost.
1903. Heppner, Oregon; cloudburst; 300 lives lost.

Floor. (1) In building, the surface on which a person walks in a room or house. It may be of masonry, bricks, tiles, concrete, earth, boards. The term usually refers to boards laid close together and nailed to timbers which are termed joists. (2) In geology and archæology, the part of a cavern corresponding in situation to the floor of a house. Here frequently there is new cave earth, covered, and therefore hermetically sealed for the purpose of the investigator, by stalagmite, which has been formed by droppings from the stalactites hanging from the roof. (3) As a nautical term, the bottom part of the hold on each side of the keelson; the flat portion of a vessel's hold. (4) In hydraulic engineering, the inner piece of the two which together form the bucket of an overshot water wheel. (5) In mining, the bottom of a coal seam, the underlay on which the coal, lead, or [illegible] rests. (6) To take the floor: To rise to address a public meeting; also to stand up to dance (Irish).

Floor-cloth, or Oil-cloth. The basis of floor-cloth is a [illegible] canvas, woven of flax, with a slight admixture of hemp. Owing to its great width, 6 to 8 yards, it has to be woven in special looms. It is made in lengths of from [illegible] yards. A length of [illegible] feet is stretched in a frame, brushed with glue-size, and rubbed with pumice-stones. It then receives two or three [illegible] coats of paint on each side. [illegible] commonly made of linseed oil and ochre, and is laid on with a trowel. Each coat on the front is smoothed with pumice-stone. When this operation is completed the cloth is transferred to the printing-room, where the pattern is printed by blocks, as in calico printing. There is a block for each color.

Floquet, Charles Thomas, sharl tō-mä [illegible], French statesman: b. St. Jean de Luz [illegible] Oct. 1828; d. Paris 18 Jan. 1896. He began life as a lawyer in Paris, where he defended the Republican journalists. On the fall of the empire he was appointed one of the deputy mayors of Paris, but was forced to resign on account of his complaisance toward the Red Republicans. Later he was elected to the Paris municipal council and in 1876 became one of the deputies for Paris. He sat in the Chamber till 1882, when he was appointed Prefect of the Seine; re-entered the Chamber in 1882 and was elected its president in 1885, but resigned in April 1888, to become prime minister. In 1889 he was again elected president of the Chamber. He aspired to the presidency of the republic, for which office he was the Radical candidate in 1887; but his career was cut short by the Panama Canal scandal, and he lost his seat in the elections of 1893.

Floquet, Pierre Amable, pē-ār ä-mäbl, French historian: b. Rouen, France, 9 July 1797; d. Formentin 6 Aug. 1881. He made Normandy's annals and personages the objects of his painstaking study in 'Norman Anecdotes'; 'History of the Parliament of Normandy' (1840-3); and 'Studies in the Life of Bossuet' (1855), the last two of which were crowned by the Academy.

Flo'ra, the Roman goddess of flowers and spring, whose worship was established at Rome in the earliest times. She is represented as a beautiful female, with a wreath of flowers on her head or in her left hand; in her right hand she generally holds a cornucopia. Her temple at Rome was situated near the Circus Maximus, and her festival, the Floralia, was celebrated from 28 April to 1 May. The later Romans identified Flora with the Greek goddess Chloris. In botany Flora signifies the plants of a region collectively, as Fauna signifies the animals. In astronomy an asteroid discovered by Hind, 18 Oct. 1847.

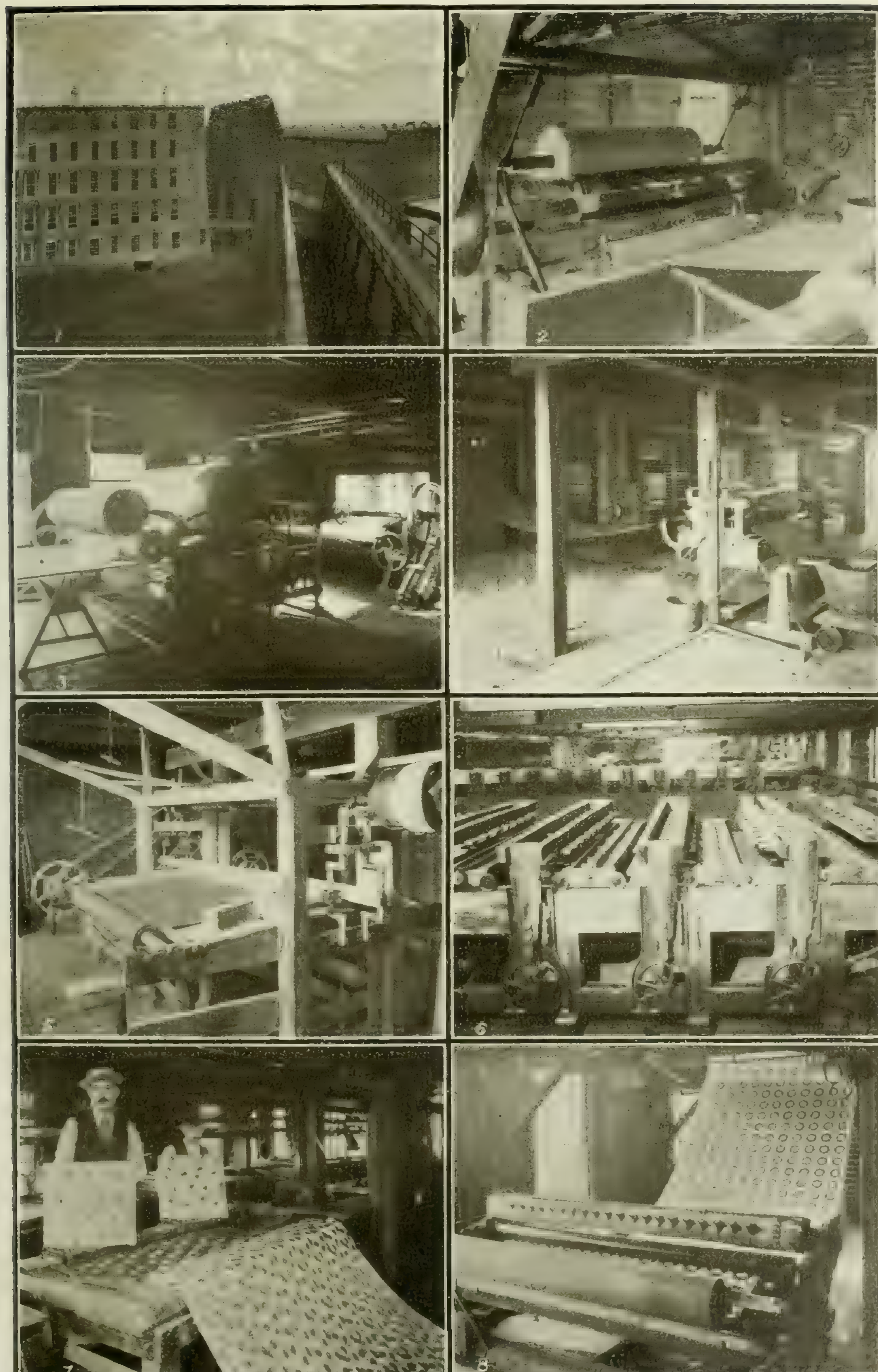
Flore'al, flō-rā-äl ("month of flowers"), the eighth month in the calendar of the first French republic (1794). It began 20 April and ended 20 May. See CALENDAR.

Flor'ence, William Jermyn (stage name of BERNARD CONLIN), American comedian: b. Albany, N. Y., 1831; d. Philadelphia, Pa., 1891. He began his career as an actor at Brougham's Lyceum, N. Y., in 1850, and soon became a great favorite with the public, especially in such characters as 'Bob Brierly'; 'Sir Lucius O'Trigger,' which latter he played to Joseph Jefferson's 'Bob Acres' with great success in a series of joint performances during the last two years of his life. He was the author of several Yankee and Irish plays.

Florence of Worcester, English chronicler: d. 1118. He was a monk of Worcester, wrote 'Chronicon and Chronicis,' a compilation from Marianus, an Irish monastic chronicler, which is of the highest authority in early British and Irish history.

Florence, Ala., a city and county-seat of Lauderdale County, on the Tennessee river, and on the Memphis and C., the Louisville, and the

MANUFACTURE OF OIL-CLOTH.



1. Fire Wall and Railroads
2. Sizing Machine.
3. Calender End of the Sizing Machine.
4. Painting Machine and Drying Racks.
5. Rubbing Machine.
6. Printing Machine Running Nine Colors.
7. Hand Printing a Mosaic Pattern.
8. Varnishing the Printed Oil-Cloth.

Nashville R.R.'s. Here are the Florence Synodical Female College, the State Normal College, Mars Hill Academy, Florence Institute, Paxton high school, a Congregational school, several churches, and a number of weekly newspapers. The city has manufactories of iron, cotton, wagons, ice, flour, stoves, etc., and an assessed property valuation of over $2,000,000. Pop. (1900) 6,478.

Florence (in Italian, *Firenze*), a province of Italy; area, about 2,262 English square miles. The surface is beautifully diversified by mountains, valleys, and plains. The climate is generally mild and healthy, and the soil very fertile, producing wheat, maize, beans, and all kinds of leguminous crops. The vine, olive, orange, citron, and fig thrive well in the low grounds; while the mountainous districts afford excellent pasture, admirably adapted for the rearing of sheep. The minerals include mines of copper, lead, and mercury; and quarries of marble, alabaster, and fine building stone. Pop. (1901) 939,054.

Florence (Italian, *Firenze*), a famous walled city of central Italy; on both sides of the Arno, 187 miles northwest of Rome. It stands in a richly wooded, well-cultivated, and beautiful valley, encircled by the Apennines. Its shape is nearly a square, the sides of which almost correspond with the cardinal points; the Arno intersects it from southeast to northwest, three of the quarters into which it is divided being situated on the right, and the fourth on the left bank of the river. The communication between the opposite sides of the river is maintained by means of seven bridges. Florence contains a great number of magnificent edifices and squares, generally adorned with statues, columns, or fountains; there are no fewer than 170 churches, 89 convents, 2 royal, and many other palaces, 12 hospitals, and 8 theatres great and small. Each angle of a street presents an architectural view fit to be drawn for a scene in a theatre. Many of the houses are palaces, fitted up with great magnificence, and some of them contain valuable galleries of pictures. The streets are mostly wide and straight; and they are admirably paved with angular blocks of sandstone.

The Piazza Reale is the largest square; it has a fine marble fountain, and an equestrian statue in bronze of Duke Cosmo I., by John of Bologna. The Piazza del Mercato Vecchio, in the centre of the city, has a marble column from which Florence radiates for one mile on each side. The Arno is decidedly superior to the Tiber at Rome. The bridge Santa Trinita, built of marble in 1559 by Ammanate, is designed in a style of elegance and simplicity unrivaled by the most successful efforts of modern artists. The bridges, and quays by which the river is bordered, afford fine views of the river, Florence being in this respect much superior to the "Eternal City." The duomo, or cathedral, a vast edifice, coated with marble, about 500 feet in length, and 384 feet in height to the top of the cross, stands in a spacious square. The church of Santa Croce, called the Pantheon of Florence, is interesting from its containing the remains and tombs of four of the greatest men of modern Italy, or indeed of modern times — Michelangelo, Galileo, Machiavelli, and Alfieri. Among the palaces are the Palazzo Vecchio, or Old Palace, inhabited by the Medici when citizens of Florence, which was begun in 1298, and finished in 1550. It is in a massive, severe, and gloomy style, with a tower 268 feet high, and is now occupied by the principal public offices. Adjoining it is the Piazza del Palazzo Vecchio, a square containing a fine collection of statues, and a noble arcade, the Loggia di Lanzi, under the porticoes of which are magnificent groups of sculpture. The Palazzo Pitti, erected in 1440, the ordinary residence of the king of Italy, is a vast and heavy structure; it is furnished in the most costly manner, and is enriched with a great number of the choicest works of art and vertú and an excellent library. Attached to this palace are the Boboli Gardens, laid out by Cosmo I. in 1550, in the classical style. Connected with these gardens is the botanical garden, a museum of natural history, the Fontana anatomical collection in wax, etc. Another fine palace, the Riccardi (built in 1440), has a noble gallery with a ceiling painted by Luca Giordano, and a library of 40,000 volumes, open to the public. But the crowning glory of Florence is its Grand Gallery, occupying the upper floor of the Ufizi, a building erected after a design of Vasari, by Cosmo I., consisting of two parallel corridors or galleries, each 448 feet in length, and 72 feet apart, united at one end by a third corridor. This contains some masterpieces of statuary, as the world-renowned 'Venus de Medici,' 'The Knife-Grinder,' the 'Fawn,' 'Niobe and Her Children,' etc. The collection of pictures comprises superb examples of all the best schools, and is said to surpass even that of the Vatican. A splendid apartment, known as the Tribuna, contains the rarest treasures of the collection, and is in itself a wonder of art, with its cupola inlaid with mother-of-pearl, and its rich marble pavement. Besides the Riccardi and Laurentian libraries, the Magliabecchi Library, containing a rare, extensive, and valuable collection of books, is also open to the public.

The literary and educational institutions of Florence are both numerous and important. At the head of these is the famous Academia della Crusca. The charitable institutions are numerous, extensive and well conducted. The common people of Florence are well clothed and have a comfortable appearance; and there are, as compared with most other Italian towns, few beggars, priests, and monks. The citizens are friendly, cheerful, and hospitable. The encouragement given under the government, to artistic and scientific studies, has conferred advantages on Florence unknown in most other parts of Italy. All sorts of foreign publications are met with here; and the facilities it affords for gratifying a taste for the fine arts, the beauty and security of the city and environs, and its salubrity and cheapness, make it, on the whole, a more desirable residence even than Rome. Manufactures silks, straw hats, articles of vertú, as intaglios, etc., jewelry, porcelain, perfumery, etc. Florence has produced more celebrated men than any other place in Italy, or, perhaps, of Europe; among others may be specified Dante, Petrarch, Boccaccio, Villani, Cosmo and Lorenzo de Medici; Galileo, Michelangelo, Leonardo da Vinci, Benvenuto Cellini, Alberti, Lapo Brunelleschi, Giotto, Andrea del Sarto, Machiavelli; Popes Leo X. and XI., and Clement VII., VIII., and XI.

Florence owes its origin to a colony of Roman soldiers sent thither by Octavianus after the victory of Philippi, to whom he allotted part of the territory of the colony of Fiesole, established about 40 years before by Sulla. Little more is known of it under the empire, and hardly any remains exist of that period, except some relics of an amphitheatre and a few inscriptions. Christianity was established here in the third century, and early in the fourth a Bishop of Florence attended a council at Rome. In the beginning of the 12th century the city had risen into importance through the industry and enterprise of its inhabitants, who had now commercial establishments in the Levant, France, and other parts, and had become money-changers, money-lenders, jewelers, and goldsmiths. In the latter end of the 14th century the wealthy family of the Albizzi became chief rulers in Florence. These again were overthrown in 1434 by Cosmo de Medici, a popular citizen and princely merchant, who assumed the first place in the state. On the fall of the republic in the 16th century a member of a lateral branch of the Medici, the line of Cosmo having become extinct, was placed by Charles V. as Duke of Florence. The ducal dynasty of Medici continued to rule till the year 1737, when, becoming extinct, they were succeeded by Francis of Lorraine, afterward emperor of Germany. From this period the history of Florence merges into that of Tuscany, until its amalgamation with the kingdom of Italy. From 1865 till 1871 it held the dignity of capital of the kingdom, the seat of government being transferred to it from Turin. It then received a considerable increase of population, and consequently a number of broad new streets have been constructed on the site of the old fortifications, and of late years its precincts have been extended in every direction. Pop. (1901) 205,589.

Florence, S. C., a city and county-seat of Florence County, on the Atlantic C. L. R.R. It has a bank and several newspapers. Pop. (1900) 4,047.

Florentine Experiment, in physics, an experiment made in 1661 by some academicians at Florence to test whether or not water was compressible. They enclosed it in a globe of thin gold, afterward hermetically sealed. In compressing the globe the water, instead of yielding, forced its way through the pores of the gold, and stood in drops on its outer surface. See PHYSICS.

Florentine Fresco, a kind of painting, first practised at Florence during the flourishing period of Italian art, for decorating walls. Like common fresco, the lime is used wet, but in this mode it can be moistened, and kept damp and fit for painting upon. See FLORENCE; ITALY.

Florentine Lake, in painting, a pigment prepared from cochineal. It is now obsolete, the greater durability in oil-painting of the lake prepared from madder having entirely superseded those prepared from cochineal.

Florentine Mosaic, the term applied to the art of inlaying tables and other plane surfaces with *pietra dura* and *pietra commesse*, carried on principally at Florence. See ART; FLORENCE; ITALY.

Florentine School, an Italian school of painting during the 14th and 15th centuries remarkable for greatness; for attitudes seemingly in motion; for a certain dark severity; for an expression of strength by which grace is perhaps excluded; and for a character of design approaching to the gigantic. The Tuscan artists, satisfied with commanding the admiration, seem to have considered the art of pleasing as beneath their notice. This school has an indisputable title to the veneration of all the lovers of the arts, as the first in Italy which cultivated them. See ART.

Flores, Juan José, hoo-ăn' hō-sā' flō'rāz, Venezuelan soldier and statesman: b. Porto Cabello, Venezuela, 1801; d. Guayaquil, Ecuador, 1 Oct. 1864. He distinguished himself as Bolivar's lieutenant in the war that secured the independence of South America. In 1823 he was governor of Pasto, and head of the army in Ecuador. His victory at Tarqui (1828) ended the war with Peru and he was made president of the republic of Ecuador (1831–5). He filled the same office in 1839 and from 1843 to 1845, when he resigned in consequence of a revolution stirred up by the liberals. He was defeated by Mosqueza in the war with Columbia at the battle of Cuaspuda, in 1863.

Flores, Venancio, vā-nän'thi-ō, South American soldier and statesman: d. Montevideo, Uruguay, 19 Feb. 1868. In 1853 he took part in an insurrection against Giro, the president of Uruguay and was elected president of the republic in January 1854. The two parties in the government were the Colored (Liberals), and the Whites (Conservatives), and the former being the stronger had elected Flores. A division in this party made it possible for a former president, Oribe, to land with troops, and Flores laid down his office, and in 1858 took refuge in Buenos Ayres. He returned later and with the help of Brazil stormed the city of La Florida in 1864 and in 1865 made a triumphant entry into Montevideo, and assumed the title of provisional governor of the republic. On 4 May 1865, he concluded a treaty of alliance with Brazil and the Argentine republic in the war against Paraguay. He won over the party of the Whites by his clemency, regained the presidency in 1866, but was assassinated on his way to the city hall, or capital of Montevideo.

Flores, flō'res. (1) *Endé* or *Mandfirei Floris*, a large island (Dutch) of the Indian Archipelago, forms one of the chain of islands which extend east from Java; length, about 200 miles; breadth, about 50 miles. It has a mountainous surface, with several volcanic peaks, one of which, Lobetobie, is 7,200 feet high. Little is known of the interior. Sandal-wood, once abundant, has become scarce. Endé, near the middle of the south coast, is said to be the principal port, and to have safe anchorage for any number of ships. The passage between the east end of the island and those of Solor and Adenara is called Flores Strait; and the part of the Pacific north of the Flores chain and south of Celebes is called the Flores Sea. (2) The most western island of the Azores, about 30 miles long by 9 miles broad, with a hilly surface, containing an extinct crater now converted into a lake. The chief products are wheat, pulse, and poultry, and great numbers of small cattle are reared. (3) An island of the North Pacific, off the west coast of British America, opposite to Vancouver's Island; lat. 49° 20′ north; lon. 125°

45′ west; length, northwest to southeast, 15 miles; breadth, from 2 miles to 6 miles. (4) A small island off the coast of Uruguay. (5) A river in Brazil in the province of Piauhy.

Florez, Henrique, en-rē'keth flō'reth, Spanish historian: b. Valladolid, Spain, 14 Feb. 1701; d. Madrid 20 Aug. 1773. He was an Augustinian ordinary who taught theology and history by presenting dogmas and annals from the standpoint of their human interest. 'Sacred Spain' (1747–73), and 'Memorials of Catholic Queens' are his most important works.

Florian, Jean Pierre Claris de, zhōn pē-ār clä-rē dē flō-ryän, French poet: b. near Anduza, Gard, France, 6 March 1755; d. Sceaux, France, 13 Sept. 1794. He made his début with some pleasing farces (1779), and added greatly to his fame with the two pastoral stories, 'Galatea' (1783), and 'Estelle' (1787); sentimental romances in the dominant taste of that time. He also wrote: 'Medleys of Poetry and Literature'; and 'Florian's Youth,' in which he recounts the story of his boyhood. In 1788 he became a member of the French Academy. While there, engaged in finishing his poem, 'Ephraim,' he was arrested by the orders of the Committee of Public Safety, but the fall of Robespierre saved him from the guillotine.

Floriculture in America.— Growing flowers as a business was unknown in America previous to about 1825; and, indeed as late as 50 years ago it was impossible to buy cut flowers in some of our leading cities. Owing to the increase of population of the eastern cities, and consequent increase of wealth and luxury, a demand for flowers began to be felt in the second quarter of the last century; and thus began the development of commercial floriculture in this country. This branch of horticulture first became prominent in the vicinity of Philadelphia and Boston. In the early days more wealth was centered in these cities, and the people there paid more attention to luxuries in home surroundings. New York was less prominent in the development of this industry. From 1830 to 1840 floriculture made considerable progress, owing to improved methods in the construction and management of greenhouses, as well as to the increased demand for flowers. The application of hot-water heat to greenhouses gave an impetus to the work, making it possible to grow better plants than had been done when heated air conducted through brick flues was the only means of keeping out the frost. Since the Civil War the development of the industry has been rapid and varied, as to extent and methods, and as to the kinds of flowers cultivated. Up to about 1885 the cultivation of plants was the leading feature of floricultural work; but since that time the rapid increase of wealth and luxury in the large cities has developed a tremendous demand for cut flowers, thus making this branch of the business the all-important one for the florist. This increased demand for cut flowers has led to specialization in floriculture and has produced the best work of the florist. Older flowers, such as the once popular camellia, have been dropped, and the rose, carnation, violet and chrysanthemum have been substituted. In this way floriculture, as we find it to-day, has been gradually evolved. There are two distinct departments of the word, viz., the growing of plants, and the cultivation of cut flowers. The plants grown mostly are various kinds of palms, ferns, rubber plants and dracænas; also ornamental an bedding stock for out-door purposes. There has been specialization in both of these main branches of floriculture. For instance, certain growers devote all their energies to palms; others concentrate on ferns; others raise bedding-plants exclusively. In flower-growing there has been even greater specialization; and it would now be difficult to find an important establishment where more than one of the leading flowers is grown. While one florist will grow roses exclusively, another will devote all his time and ingenuity to the improvement of the carnation, a third will grow nothing but violets, and a fourth will concentrate on chrysanthemums. These four flowers are the most important cut flowers, their commercial importance being in the order named. The most recent statistics on floriculture in the United States are to be found in the United States Census of 1900. At that time there were 8,799 floricultural establishments, representing an investment (land, equipment, etc.), of $52,462,-419, and selling flowers and plants to the amount of $18,759,464 annually. About two-thirds of this amount was realized from cut flowers, the rose bringing in $6,000,000, the carnation $4,000,000, the violet $750,000, the chrysanthemum only $500,000, owing to the shortness of the season. The annual expenditure for labor was $4,155,179, or 22.6 per cent. of the total receipts. Since the figures given above are something less than the wholesale price, and the profit of the retailer is about 100 per cent., it is clear that the public spends annually some $30,000,000 on flowers.

There are few adequate treatments of floriculture. As among the best may be mentioned: Henderson, 'Practical Floriculture'; Hunt, 'How to Grow Cut Flowers'; Taft, 'Greenhouse Management.' Consult also Bailey's 'Garden-Craft' series, and his 'Cyclopedia of American Horticulture.' See Botany; Breeding Plant; Horticulture; Flower; Flower and Insects; Garden; Inflorescence; Greenhouse; Cross-Fertilization; Fertilization, Etc.

Florida (Sp. flowery, a name given to the country by Ponce de Leon because he discovered it on Easter Day, Sp. *Pascua florida* or *de flores*, flowery Easter; or, according to some authorities, on account of the exuberance of flowers which he saw), the southeasternmost State of the Union, sometimes called "the Everglade State," and also "the Peninsular State." It is situated between lat. 24° 30′ and 31° N. and lon. 79° 48′ and 87° 38′ W. Alabama and Georgia bound it on the north, the Atlantic Ocean on the east. On the South, Florida Strait, which connects the Gulf of Mexico with the Atlantic, separates the peninsula from Cuba, and the Bahamas. West of the peninsula and south of the western extension of the State is the Gulf

of Mexico. The extreme western boundary is the Perdido River in Alabama.

Florida is mainly a peninsula of irregularly rectangular form. The northern part is continental, and extends about 400 miles from east to west. From north to south the peninsular extension is about 375 miles in length, and nearly 100 miles in width, the total length of the State north and south being about 450 miles. From Biscayne Bay, near its southeastern extremity, stretches a series of islets or keys, the only one of importance being Key West, situated at the lower end of the chain.

The physical features of the State are decidedly dissimilar to those of the other Southern States. The geological upheaval resulting in its formation left neither table-land nor mountain from which to view ocean and gulf, the most elevated portion of the State barely reaching the dignity of a hill-country. Its area is 58,680 square miles, 4,440 being lakes, lagoons, and rivers. Its coast-line, excluding islands, is 1,145 miles, 470 miles of it being in the Atlantic Ocean. Capital, Tallahassee.

Surface, Soil and Drainage.— The northwestern part, continuing the Alabama uplands, is a hilly rolling country sinking to a flat strip of coast. The east is part of the Atlantic coastal plain. The peninsula is a surface of sand and marsh, lying in the north on a basis of Upper Eocene or Vicksburg limestone; in the south on one of coral whose southern extremity is the bounding wall of the Gulf Stream, silted up at the end into the "keys." These have spread by deposits and vegetable growth into habitable islands, and in the course of ages will be joined to the peninsula, which itself is yet but land in the making. Almost everywhere the water lies close below the surface, which is dotted with springs, some of which are charged with carbonates and sulphuretted hydrogen; many fresh and of immense size, and of crystal clearness. One of the most famous is near St. Augustine, two miles out at sea, and boils so violently that the waves break against it as against a sunken reef. Another large one is in St. George's Sound, opposite Lanark. The wonderful Silver Spring, at the head of navigation on the Ocklawaha River, near Ocala, Marion County, has an estimated outflow of 300,000,000 gallons daily. The Blue, in the same county, the Wekiva in Orange County, and the Wakulla near Tallahassee, are also famous.

As the soil is a mere surface deposit with no volcanic upheaval, the State has no real hills; but the centre has a watershed in the shape of a ridge from 100 to 300 feet high, with a summit level 200 miles north of the strait, from which low sand-terraces decline each way to the sea, with countless lakes and swamps at their bases. Many of the lakes are aggregates of the great springs before mentioned. The largest is Okeechobee in the south, 1,200 square miles in area and [illegible] feet above the sea-level, its waters sinking into the Everglades; a bordering rim of sand about [illegible] miles wide divides it from the Atlantic. Others are Monroe, George, Kissimmee, Crescent, Dexter, Apopka, Harris, Orange, and Eustis. Most of them are shallow and usually connected by fresh-water streams. On the higher levels the terraces are covered with a magnificent growth of large pine-trees; on the lower levels are prairies and marshes timbered with cypress-trees, and in which are "hummocks," which are dry elevations, covered with a great variety of hardwood, and cabbage-palms. The basins of the draining streams are mostly marshy jungles of cane-brake and vines and semi-tropical trees. In the southernmost portion are the remarkable Everglades, forming a district 160 by 60 miles in extent, and containing 3,600 square miles, both land and water; and overflowed marsh hidden by tall grass, and thickly dotted with dry "hummocks" ranging in size from those just large enough to stand on, up to those covering a square mile or more, and covered by a jungle of vines and shrubs, pine, and palmetto. The eastern part is a maze of these islands and small shallow bayous. The islands were once really such in the ocean, the water around them having silted up and been overgrown with vegetation. The Everglades are separated from the Gulf by extensive cypress swamps; the forests extend down the west coast, narrowing out around the cape, and stretch up along the Atlantic coast. The latter, except in the extreme north, is almost harborless, a line of narrow sand-spits with interior lagoons, the type of the whole southern coast; but the gulf side, otherwise formed in the same fashion, is pierced with many deep bays and harbors — Pensacola, Santa Rosa, St. Andrew's, St. George's, Appalachee, Tampa, Hillsboro, Charlotte Harbor, Oyster, Ponce de Leon, Cedar Keys, etc.

The great river of Florida is the St. John's, rising in Cypress Swamps, just north of the Everglades, and flowing north parallel with the ocean, threaded on a series of lakes; 150 miles from its mouth becoming a mile wide, and in its lower course six or seven, a miniature Amazon in size and character and draining a similar country. Pleasure-steamers navigate it 250 miles, and the tributary swamp-rivers several hundred more. Its total course is 350. The Kissimmee, flowing into Lake Okeechobee from Kissimmee Lake, is also a favorite of tourists and sportsmen. The leading streams of the west are the Suwanee; the great Appalachicola from Georgia, 90 miles long under that name, with a course of nearly 600 through the Chattahoochee; the Choctawhatchee (180 miles), and Escambia (250 with the Conecuh) from Alabama, the latter navigable to the Conecuh.

Climate.— The climate of Florida is not subject to prolonged and severe winters with great ranges in temperatures. The annual precipitation is from 58 to 60 inches, ranging from 6 to 8 inches in the fall and winter — the dry season — to 18 to 20 inches during the summer. The normal sunshine is about 60 per cent. The normal mean temperature for January ranges from 60° to 70° F., that for July being 80° and above. The hottest months are June, July, and August, the heat being tempered by frequent showers. Already famed as the Riviera of America, offering hope to the invalid and pleasure and comfort to the robust, Florida occupies a unique place among the States of the Union. The large immigration of a rich and cultured class has had a great influence on the social, political, and business development of the State.

Flora and Fauna.— These are naturally affiliated to those of the West Indies and South America. The forests are estimated at 25,000,000 acres, two thirds the area of the State; largely consisting of live-oak, hickory, long-leaved pine, pitch-pine, and cypress. Prof. A. H. Curtis, a


FLORIDA
SCALE OF MILES
0 5 10 20 30 40 50 60 70 80 90 100
Population of places is indicated by different lettering, thus
25,000 and over JACKSONVILLE
5,000 to 25,000 Tampa
1,000 to 5,000 Ft.Brook
500 to 1,000 Greencove
Smaller Places St.Marys
Railroads
GEORGIA
ALABAMA
ATLANTIC OCEAN
GULF OF MEXICO
FLORIDA STRAIT
BAY OF FLORIDA
OKEFINOKEE SWAMP
JACKSONVILLE
Lake Okeechobee
Tampa
Orlando
Daytona
Fort Myers
Key West
Dry Tortugas
Cumberland I.
Fernandina
St. Augustine
Pt.St.Joseph
C.San Blas
C.St.George
JACKSON
GADSDEN
LIBERTY
WAKULLA
TAYLOR
MADISON
HAMILTON
LEVY
MARION
VOLUSIA
CITRUS
HERNANDO
PASCO
ORANGE
OSCEOLA
MANATEE
DE SOTO
LEE
DADE
SANTA ROSA
WALTON
Longitude West from Greenwich

1. The Plaza, St. Augustine.
2. Jupiter Light.

distinguished botanist, says that Florida has a greater variety of trees than any other State in the Union. Florida has many trees peculiar to itself, or almost so, in the United States — the wild orange, cocoanut, and Indian almond, mahogany, satinwood, and manchineel, cachibou and kino-gum, etc. The tropical fruit acclimated there is noted below. The alligator, green turtle, and sponge, indicate the tropic nature of the State.

Fish and Fisheries.— Florida's enormous coast-line in the mid-continental seas gives its fisheries the greatest extent and value of any State south of Virginia; they employ seven or eight thousand men. Foremost is that of the red snapper, utilizing some 200 vessels besides hundreds of boats, the headquarters being Pensacola; the catch is over $2,000,000 a year, mostly packed in ice and sent North. Shad, mullet, and green turtle are also caught in large quantities. The sponge fishery is peculiar to Florida, and centres in Key West; it has produced as much as $250,000 a year. Alligators are caught for their skins.

Agriculture and Forest Products.— The rich phosphatic soil mingled with decaying vegetation, the large rainfall, and warm climate render Florida enormously fertile, and dictate its representative crops. It of course raises corn and other cereals for its own use — in 1902 it produced 5,180,000 bushels of corn from 600,000 acres of land — and at last report had over 500,000 neat and 80,000 dairy cattle; but its chief export crops are semi-tropical. Sugarcane, Sea Island cotton, and rice; 160,000 bushels a year of the last named; sweet potatoes, over 2,000,000 bushels a year; Irish potatoes, 200,000 bushels; peanuts, over 1,000,000 bushels; cassava, nearly 10,000,000 pounds; tobacco, 1,600,000 pounds in 1902; with some 7,000,000 watermelons and 3,500,000 muskmelons a year, besides general market-gardening products for the North, are the typical field crops of the State. Several thousand acres are devoted to watermelons for the seed alone, for which there is an extensive northern market. The orchard crops are rich in tropical products — lemons (2,357 boxes in the census year), limes (22,714 boxes), grape-fruit (2,306 boxes), guavas (1,645,000 fruit), Japanese plums (75,110 fruit), olives, figs (66,680 pounds), cocoanuts (136,600 nuts), etc.; but the two leading crops are oranges and pineapples. The former has been subject to immense vicissitudes. Early in the nineties it was the one speculation of central Florida, and the product rose to 5,000,000 boxes in one year; then the terrible cold wave of 1894–5 froze millions of young trees to the roots, often splitting them in two. The older trees, where well handled, generally survived, but another cold wave in 1899 — giving native Floridans the unprecedented sight of several inches of snow — destroyed a large part of those also: the two disasters killed three fourths of all the orange trees in the State. The crop sank to 125,000 boxes or so, and most of the growers abandoned the business, thinking a permanent change of climate had set in; but it is now known that these frosts occurred now and then in earlier times as well, and growers are recovering courage, though the industry is shifting toward the southwest coast. The crop for 1902 was about 750,000 boxes, over treble that for the census year. The next greatest orchard crop — though peaches and pears are considerably grown — is the pineapple, raised mainly in the southeastern counties. Florida in the census year produced nearly 3,000,000 of the fruit, against 440 from California and none from any other State.

In 1902 the Florida East Coast & Drainage Sugar Company was formed to drain the Everglades, which will reclaim some millions of acres of valuable agricultural land.

The forest products are usually ranked under manufactures. The lumber and timber product of Florida in 1899–1900, with the tar, turpentine, and ship stores, amounted to $17,572,999, or nearly as much as all the rest of the State's manufactures together. The turpentine and rosin — 236,778 barrels of the former, 772,537 of the latter — were valued at $6,469,605, and the industry employed 15,073 hands, or toward half the industrial workers of the State. The industry has grown from almost nothing within the decade, there being in 1890 only 484 hands and $191,859 product.

Minerals.— Florida has no metals, and its mineral industries are of rock and earths. The chief is the mining of phosphate rock for fertilizers (q.v.), in which it rivals any other district of the world. It is in various forms — hard and soft rock, land and river pebble, and vertebrate remains. The hard rock — much the most valuable, containing 80 per cent phosphate of lime — is found in a belt skirting the Gulf from Tallahassee nearly to Tampa. It was discovered in 1888, and since then the product has risen to some 750,000 tons a year of all kinds — 500,000 being hard rock, nearly all exported to Europe, principally Germany. The river pebble is only worked on the Peace and Alafia rivers, by dredges and pumps. Most of the fuller's earth used in the United States is also from Florida. At Ellenton, on the Manatee River, 60,000 tons has been produced in a year, and at Quincy 30,000 tons. Some $40,000 a year of kaolin also goes out.

Manufactures.— The greatest industry of Florida, aside from the forest products, is the tobacco and cigar manufacture, of which the heart is Tampa and Key West; it was developed by the immigration of Cuban cigar-makers, and still uses mainly Havana leaf. Some 300,000,000 cigars a year are turned out, and the total value of tobacco products manufactured in the census year was $10,891,286; the industry employed 6,461 wage-earners. The fertilizer industry from phosphate rock amounts to over $500,000 a year, against less than $100,000 in 1890, and nothing two years before. Wooden boxes and barrels, cedar for lead-pencils, sugarcane syrup, cotton-seed oil, and meal are also to some extent exported, though the consumption is largely at home. Jacksonville has two establishments for canning pineapples, guavas, etc.

Commerce and Transportation.— Florida's position makes it the natural outlet for exports to the West Indies; but till late years unimproved harbors and inferior railroad equipment have checked its commerce. Within the past 15 years, however, Congress has expended over $6,000,000 on its river and harbor improvements (appropriating nearly $3,000,000 more in 1902); and its railroad lines have more than trebled in mileage, and increased in even greater ratio in quality of service. The mainland harbors on its immense peninsular coast-line, with its noble

island port Key West, do an export trade of toward $20,000,000 a year, with some $2,000,000 of imports. About 3,000 vessels a year, of over 2,500,000 gross tons, clear from Florida ports. The chief exports are timber and lumber (over $7,500,000 a year), naval stores, fruits, corn, cotton, tobacco and cigars, phosphate rock and fertilizer, fish, and horses, mules, and cattle to Cuba. The largest exporting places are Pensacola, Tampa, Jacksonville, and Key West. There are important steamer lines running from Jacksonville to Charleston, New York and Boston; from Tampa to Havana and Porto Rico (great sums having been recently expended on its terminal facilities); from Key West to Havana, Galveston, New Orleans, and New York; and from Miami to Nassau and Cuba; also coasting lines from Fernandina, Apalachicola, Carrabelle, and Punta Gorda. There is much tourist and business navigation on its fine rivers and bays. The railroad mileage is now some 3,500, of which 2,800 is main track; there are several through express trains to and from the North daily, and three great trunk lines traverse the peninsula — the Atlantic Coast Line, Seaboard Air Line, and Florida East Coast.

Banks.— On 1 Jan. 1902 there were 25 incorporated banks in the State, with assets of $6,149,852.82; and capital, surplus, and undivided profits of $1,169,645.70. Five of these were savings banks or had savings departments, with assets of $2,632,928.31.

Finance.— The assessed valuation of the State is slightly over $100,000,000; and there is no floating debt, but a surplus of $228,074.19 in the treasury on 1 Jan. 1903. The bonded debt is $350,000 in 7's of 1871, and $925,000 in 6's of 1873. The State tax is five mills. The county taxes produce over $1,250,000 a year, the school districts over $70,000.

Education.— At the end of 1902 there were about 2,400 public schools, and 2,799 teachers, 1,782 of them female. The average monthly salary was $44.49 for white males and $35.44 for white females. Total paid for salaries, $569,733.33; total expenditure on schools, $775,000, or about $1.35 per capita; about half the average for the Union, and one of the lowest averages among the States. The average attendance for the year was 55 days for white children, 41 for colored. The illiterates above 10 number over one fifth of the population. This is misleading, however, unless classed by color: the illiterate whites numbered 19,184 out of 297,812, or 6.4 per cent, while the illiterate colored numbered 65,101 out of 230,730, or over 35 per cent. The educational status is gradually improving. There are some 30 high schools in the State. The Constitution provides for two normal schools, a white and a colored; the former is at De Funiak Springs, the latter at Tallahassee. There are also three private normal schools. For colored secondary education there are three institutions at Jacksonville and one at Live Oak. For whites there are, besides the State Agricultural College at Lake City, seminaries for East Florida at Gainesville, West Florida at Tallahassee, South Florida at Bartow. There are also several private and denominational colleges, including the John B. Stetson University at Deland, affiliated with the University of Chicago, and Rollins College at Winter Park.

Charitable and Penal Institutions.— There is a State hospital for the insane at Tallahassee accommodating about 1,000 patients, and treating some 300 new ones a year; a school for the blind and for deaf-mutes at St. Augustine; and a State reform school. The State penitentiary at the end of 1902 had 1,033 inmates; 449 received during the year, of whom 413 were colored. The State farms out its convicts for mining phosphate, etc.

Religious Denominations.— The strongest in the State are the African Methodist Episcopal, the Methodist Episcopal South, the Regular Baptist South, the Regular Baptist Colored, Roman Catholic, Methodist Episcopal, Protestant Episcopal, Presbyterian, Disciples, and Congregational.

State Government.—The Constitution is of November 1886, and made sweeping changes from the former one in the direction of democracy. The State and county officers had formerly been mostly appointed by the governor, and the Supreme Court justices were appointed for life; under the present Constitution all are elected, except circuit judges, and the judges' terms are six years. The governor is elected for four years, and cannot be re-elected for an immediately succeeding term. His salary is $3,500. His veto may be overridden by a two thirds vote of the members present in both Houses. In case of vacancy, the succession devolves on the president of the Senate and the speaker of the House successively. The legislature consists of 32 senators and 68 representatives, and meets biennially, with sessions limited to 60 days except at their own expense. There is a railroad commission to enforce reasonable rates of freight and passenger carriage. The divorce law requires two years' residence. Counties have local option at the request of one fourth of the registered voters. There are 1,258 militia. The State has two representatives in Congress. It is overwhelmingly Democratic in politics; in the legislature of 1903 there are 67 Democratic representatives and one Republican.

Population.— 1830, 34,730; 1840, 54,477; 1850, 87,445; 1860, 140,424; 1870, 187,748; 1880, 269,493; 1890, 391,422; 1900, 528,542. The foreign-born numbered 23,832, mostly West Indians. The colored population was 230,730, or a little over two fifths. The present population, based on estimates of the census officials, is about 575,000.

The State has 45 counties, which, with their capitals, are as follows:

Alachua, Gainesville.
Baker, MacClenny.
Bradford, Starke.
Brevard, Titusville.
Calhoun, Blountstown.
Citrus, Inverness.
Clay, Greencove Springs.
Columbia, Lake City.
Dade, Miami.
De Soto, Arcadia.
Duval, Jacksonville.
Escambia, Pensacola.
Franklin, Apalachicola.
Gadsden, Quincy.
Hamilton, Jasper.
Hernando, Brooksville.
Hillsboro, Tampa.
Holmes, Westville.
Jackson, Marianna.
Jefferson, Monticello.
Lafayette, Mayo.
Lake, Tavares.
Lee, Myers.
Leon, Tallahassee.
Levy, Bronson.
Liberty, Bristol.
Madison, Madison.
Manatee, Braidentown.
Marion, Ocala.
Monroe, Key West.
Nassau, Fernandina.
Orange, Orlando.
Osceola, Kissimmee.
Pasco, Dade City.
Polk, Bartow.
Putnam, Palatka.
St. John, St. Augustine.
Santa Rosa, Milton.
Sumter, Sumterville.
Suwanee, Live Oak.
Taylor, Perry.
Volusia, Deland.
Wakulla, Crawfordville.
Walton, DeFuniak Springs.
Washington, Vernon.

The chief cities are Jacksonville, on the St. John's, with a population of 28,429, in 1900, in-

creased to about 40,000 in 1903; Pensacola, in the extreme west, 17,747; Key West, 17,114; Tampa, on the west coast, 15,839. No other place has as much as 5,000 people; and only two over 4,000 — St. Augustine, on the east coast, 4,272, and Lake City, between Jacksonville and Tallahassee, 4,013. Between 3,000 and 4,000 are Gainesville, Ocala, Palatka, Fernandina, and Apalachicola. Tallahassee, the capital, has 2,981.

History.— The earliest attempted colonization of the North American mainland was in Florida, and the first white settlement was St. Augustine. Juan Ponce de Leon discovered the coast a little north of St. Augustine 27 March 1512; was made governor, and authorized to colonize the "Island of Florida," as it was then supposed to be, in 1513; and sought there for the "Fountain of Youth." Thenceforward it was the highway of Spanish explorers. Vasquez de Ayllon raided it for slaves 1520–6, Pánfilo de Narvaez began his fatal expedition westward in 1528 from Pensacola Bay; Hernando de Soto his in 1539 from Tampa Bay; Tristan de Luna in 1559 explored northward from Pensacola Bay. Coligny designing to found a Huguenot colony and refuge in the New World, René de Laudonnière in 1564 built Fort Caroline on the St. John's; in 1565 Pedro Menendez de Aviléz captured the fort, massacred the French there and in two detachments outside, "not as Frenchmen but as heretics," and built St. Augustine; in 1567 Dominique de Gourgues in turn exterminated the Spaniards at the settlement that had replaced Fort Caroline, "not as Spaniards but as assassins." St. Augustine was overlooked; but in 1586 Sir Francis Drake destroyed it. All through the 17th and early 18th centuries the Spaniards in Florida harassed, or set on the Indians to harass, the English colonies, from St. Augustine as headquarters, especially after Georgia was settled; and St. Augustine was repeatedly attacked by colonial expeditions. The Spaniards did but little toward settling the country, however. In 1763 East and West Florida — the latter west of the Apalachicola, and including parts of modern Alabama and Mississippi — were ceded to Great Britain, and in the next 20 years more than 25,000 whites had settled there. In 1783 it was retroceded to Spain, and most of the English settlers withdrew. In 1795 West Florida was sold to France. After the Louisiana Purchase of 1803 the United States claimed up to the Perdido as part of "Louisiana"; the claim was not then pressed, for fear of war; but in 1810, the Spanish monarchy being overthrown and the king a prisoner, the United States took possession of all but Mobile, which was occupied in 1813 during the War of 1812. Meantime and afterward, the Southern States found East Florida an intolerable thorn in their flesh. The so-called Spanish "government" there was mere anarchy, partly from there being no stable home government to control it; Indian bands raided Georgia and escaped over the border, British and Spanish traders intrigued with them, and it was an Alsatia for fugitive slaves which drove the slaveholders wild. Congress authorized Madison to take "temporary possession" in 1811, but nothing was done; in 1818 Jackson invaded it to punish Spanish assistance to the Seminole raids and withholding fugitive slaves, captured St. Mark's and Pensacola, and hanged Arbuthnot and Ambrister, two British adventurers making their account by furnishing supplies and possibly other help to the Indians. The district being both profitless and untenable to Spain, she ceded it to the United States by treaty of 22 Feb. 1819, in exchange for government assumption of $5,000,000 claims of American citizens against Spain. The latter only ratified it in 1821 (see ANNEXATION). In March 1822 it was admitted as a Territory. The two sections, East and West Florida, both from geographical and political reasons, had no sympathy with each other, and repeatedly petitioned Congress for separation, without avail. Especially West Florida, as late as 1869, voted for annexation to Alabama, which offered the State $1,000,000 for it; but no further steps were taken. On 11 Jan. 1839 a convention framed a constitution for the State of Florida; but it was not admitted to the Union till 3 March 1845, paired with Iowa, as a slave State with a free State. The Constitution, forbidding emancipation of slaves by the legislature, roused a violent debate in Congress over admission. From 1835 to 1842 raged the bloody Seminole war (q.v.), ending in the deportation of the tribe to Indian Territory in 1843. On 10 Jan. 1861 an ordinance of secession was passed, 62 to 7; and on 4 Feb. the Florida delegates took their seats in the Confederate Congress. The government posts nearly all fell into Confederate hands; but Fort Pickens, off Pensacola, was retained, and formed a nucleus for recapture. After 1863, however, the Union forces were employed in other quarters; and by the battle of Olustee, 20 Feb. 1864, the State was lost to the Union till the close of the War restored it. On 13 July 1865 a provisional government was formed; on 25 October a State convention met, and on the 28th annulled the ordinance of secession. A new constitution was adopted without slavery, and a legislature organized in 1866; but on 2 March 1867 it was brought under the Reconstruction Act, and became a part of the Third Military District. A constitution of 25 Feb. 1868 chose officers to hold till January 1873, and by act of 25 June 1868 Florida reorganized as a State. Reconstruction conditions here were as anarchic and deplorable as elsewhere (see ELECTORAL COMMISSION; RECONSTRUCTION); but in the last 20 years the enormous investments of Northern capital in industries and railroads, the national expenditures on harbors, etc., have made it a strong and thriving State. Consult: Norton, 'Handbook of Florida' (1892); Fairbanks, 'History of Florida' (1871); Barbour, 'Florida' (1884).

CHAS. H. SMITH.
Secretary Board of Trade, Jacksonville.

Florida Agricultural College, an important educational institution at Lake City, Florida, established in 1884. It is under the direct control of a State board appointed by the governor. There are 200 students of both sexes.

Florida Blanca, José Moñino, hō-sā' mōn-yē'nō flō-rē'thä blän'kä, COUNT OF, Spanish statesman: b. Hellin, Murcia, 21 Oct. 1728; d. Seville 20 Nov. 1808. He was Spanish ambassador at Rome during the pontificate of Clement XIV., and particularly distinguished himself by his activity in the abolition of the order of the Jesuits, and in the election of Pius VI. In 1777 he became minister of foreign affairs, and at once

acquired almost unlimited authority in Spain. He introduced post-coaches, and caused the post-roads to be made practicable; directed his attention to the most important subjects of general police, particularly in the capital; embellished Madrid, and was on every occasion the active friend of the arts and sciences. His attack upon Algiers in 1777, and the siege of Gibraltar in 1782–3, were unsuccessful; but the result of his co-operation with the English colonies of North America in securing their independence was more favorable to Spain. After the accession of Charles IV., his enemies succeeded, in 1792, in effecting his disgrace. He was imprisoned in the citadel of Pampeluna, but was soon restored to liberty and banished to his estates. He appeared once more upon the political stage in 1808, when he was president of the extraordinary Cortes.

Florida Cape. See CAPE FLORIDA.

Florida, Gulf of. See FLORIDA STRAITS.

Florida Jay. See JAY.

Florida Keys, or **Reefs,** in Florida, a chain of small islands, keys or reefs, and sandbanks, extending southwest from Cape Florida, about 220 miles. They are very considerable in number, but only a few are of any importance. Among these may be mentioned Cayo Largo, Indian Key, Long Island, Old and New Matacombs, Cayo de Boca, and Key West, on which the city of Key West is built.

Florida Straits, or **New Bahama Channel.** The gulf waters separating Florida from Cuba and the Bahamas, and traversed by the Gulf Stream. The total length is 300 miles, with a width of from 50 to 150 miles.

Florida, Treaty of. In American history, a treaty signed between Spain and the United States, 22 Feb. 1819, by which Spain conceded the Floridas to the United States. Until the final ratification of the treaty Congress had passed a law empowering the President to appoint a governor, and Gen. Andrew Jackson assumed command of the Florida region. Gen. Jackson issued a proclamation at Pensacola requiring obedience to United States authority. See FLORIDA; UNITED STATES — ARBITRATION IN THE.

Florin, the name of a coin first struck in Florence in the 13th century. The silver florins of Holland are worth about 40 cents. The British and Austrian florins are each worth 50 cents. The English florin was first coined in 1849. See NUMISMATICS.

Florio, Caryl. See ROBJOHN, W. J.

Florio, John, English lexicographer and translator: b. London of Italian parents about 1553; d. 1625. He taught French and Italian in Oxford University, and was appointed by James I. teacher of languages to the queen and Prince Henry. His chief works are his great Italian and English dictionary, 'A World of Words' (1598, improved edition 1611), and his translation of 'Montaigne' (1603).

Floris, flō'ris, **Frans** (originally **de Vriendt**), Flemish painter: b. Antwerp 1517; d. there 1 Oct. 1570. He was called by his contemporaries the Raphael of Flanders. He went to Italy, where his taste, particularly in design, was improved by the study of the masterpieces of Michelangelo; but he never equaled the grace and purity of form which distinguished the Florentine and Roman masters. His style was grand; but his coloring and his figures are reproached with dryness and stiffness. Most of his works, and in particular his triumphal arches, made on the occasion of the entry of Charles V. and Philip II. into Antwerp, and his 'Twelve Labors of Hercules,' have often been engraved by skilful artists. His paintings are to be met with in Flanders, Holland, Spain, Paris, Vienna, and Dresden.

Flor'izel, in Shakespeare's 'Winter's Tale'; the Prince of Bohemia, hero of the drama, and the lover of Perdita.

Flo'rus, Roman historian, of the 2d century A.D., probably a native of Spain or Gaul. He is variously styled in the manuscripts; in some L. Annæus Florus, in others L. Julius Florus, in others L. Annæus Seneca, and in one simply L. Annæus. He wrote an abridgment (epitome) of Roman history in four books, from the foundation of the city to the first time of closing the Temple of Janus, in the reign of Augustus. His style is florid, and not sufficiently simple for history. The best edition is that of Duker (Leyden 1744); later ones are by Titze (1819) and Seebode (1821).

Floss Silk, the portions of raveled silk broken off in reeling the silk from the cocoons, carded and spun into a soft coarse yarn, and used for common fabrics. See SILK.

Flotow, Friedrich (frēd'riH flō'tō) **von,** German musical composer, b. Teutendorf, Mecklenburg-Schwerin, 27 April 1812; d. Wiesbaden 24 Jan. 1803. His earlier operas (which include one called 'Rob Roy') did not find favor among the Parisian opera-house directors, so he had to content himself with performances in the private theatres of the aristocracy. This brought him gradually into notice, however, and his 'Naufrage de la Méduse' was publicly produced in 1839. 'Alessandro Stradello' was first performed at Hamburg in 1844, and his most successful opera, 'Martha,' was originally given at Vienna in 1847. His subsequent works, such as 'Indra' (1852), 'Rübezahl' (1854), 'Albin' (1856), 'L'Ombre' (1869), achieved but small success.

Flotsam, Jetsam, and **Ligan,** in law, flotsam, or floatsam, is derelict or shipwrecked goods floating on the sea; jetsam, goods thrown overboard which sink and remain under water; and ligan, goods sunk with a wreck or attached to a buoy, as a mark of ownership. When found such goods may be returned to the owner if he appear; if not, in England, they are the property of the crown. See DERELICT; SALVAGE.

Flounder, any of several of the more common and useful flat fishes (q.v.) of northern waters. The commonest American species are the "summer" and "winter" flounders. The latter (*Pseudopleuronectes americanus*) is dark rusty brown, more or less spotted, about 15 inches long when large, and weighs one to two pounds. It is caught in the colder months from Chesapeake Bay to Labrador, and is excellent eating. The "summer" flounder (*Paralichthys dentatus*) becomes twice as large, is light olive brown, studded, when adult, with numerous small white spots, and is excellent eating. The "four-spotted" flounder (*P. oblongus*), and the

Gulf species (*P. albiguttus*), are closely related. On the Pacific coast several good species are known; and the British coast has a valuable species in *Pleuronectes flesus*, closely resembling the plaice (q.v.).

Flour and Meal Insects. Various forms of small whitish caterpillars and darker-colored "worms" are commonly found in flour and meal and manufactured cereal products of different kinds. The most prominent of these is the Mediterranean flour moth (*Ephestia kuehniella*), which has been termed a veritable scourge in flouring-mills. It was practically unknown as a pest until 1877, and in North America is still limited to portions of California, Minnesota, New York, and Pennsylvania, where flour-milling is an important industry. The moth has a wing-expanse of a little less than an inch, and is of a pale lead-gray color. The caterpillars are whitish, with long but inconspicuous hairs, and make the trouble while searching for a proper place for transforming to the pupa stage. Wherever it crawls it drags after it a large quantity of silk, with the result that flour becomes felted together and lumpy and the mill machinery gets clogged, requiring frequent and expensive stoppages. The entire life cycle of this insect may be accomplished in 38 days, hence in well-heated mills or other buildings inhabited by the insects from four to six generations may be produced. When a mill is found infested the entire building must usually be fumigated. Sometimes a whole district becomes overrun, and in this case great care must be observed that the insect does not spread from one mill to another. Various remedies are used for eradicating the pest, including the free use of bisulphid of carbon and hydrocyanic-acid gas, the use of "steam-sweepers" and "elevator brushes."

The Indian-meal moth (*Plodia interpunctella*) somewhat resembles the preceding, but is smaller; the outer halves of the fore-wings are dark greasy brown with metallic reflections, and the larva usually has a reddish or greenish tinge. It has the same habit of webbing up flour, but is not so great a pest as the Mediterranean flour-moth, possibly because it has a larger range of food material, feeding on nearly all forms of dried vegetable matter, among which are dried fruits and jellies, which have earned it the title of "pantry moth." It is to be found in nearly every store and household, and particularly where dried vegetable foods are neglected for any length of time. The meal snout-moth (*Pyralis farinalis*) is rarer than the preceding, and seldom does injury to flour or meal, although it spoils clover hay.

Two species of beetles (*Tenebrio molitor* and *obscurus*) and their larvæ are popularly known as "meal-worms," both in this country and abroad. The former is a shining brown beetle over half an inch long, and produces a yellow meal-worm: the latter is dull black, and produces a dark brown meal-worm. They are most apt to be troublesome in dark locations, in feed-stores and in stables; but are useful when raised under control, since they are salable as food for mocking-birds, nightingales, and other cage birds.

Flour beetles or "weevils" are little flattened reddish beetles of the same family (*Tenebrionidæ*) as the meal-worms and are great pests in mills and storehouses. The chief source of annoyance from these insects is due to their imparting a highly offensive and persistent odor to the substances which they infest, which include various drugs, snuff, capsicum, ginger, dried peas and beans, baking powder, nuts, and cabinets of dried insects. Several species occur in America. They differ somewhat in structure and in habits, but may be controlled by the use of bisulphid of carbon.

Flourens, Marie Jean Pierre, mä-rē zhŏṅ pē-ār floo-roṅ, French physician and physiologist: b. Maureilhan, department Hérault, 15 April 1794; d. Montgeron, near Paris, 6 Dec. 1867. His first scientific writings, which were distinguished by their perspicuous style and analytical precision, appeared in 1819. In 1828 he was elected a member of the Academy of Sciences, in 1830 was appointed to the chair of comparative anatomy at the Jardin des Plantes, and in 1833 succeeded Dulong as permanent secretary to the Academy of Sciences. In 1840 he was admitted a member of the French Academy. In 1846 he was created by Louis Philippe a peer of France, but he was deprived of this dignity by the revolution of 1848. Flourens combined with profound scientific knowledge great literary talent. His works are very numerous, but the following may be mentioned particularly: 'Recherches expérimentales sur les Propriétés et les Fonctions du Système nerveux' (1824); 'Expériences sur le Système nerveux' (1825); 'Developpement des Os' (1842); 'Anatomie de la Peau' (1843); 'Mémoires d'Anatomie et de Physiologie comparées (1844); 'Buffon' (1844); 'De l'Instinct et de l'Intelligence des Animaux' (1841); 'De la Longévité' (1854); De la Vie et de l'Intelligence' (1858); 'Œuvres de Buffon' (1853–5); 'Des Manuscrits de Buffon' (1859); 'Éloges historiques' (1857). Flourens was the first to demonstrate experimentally that the substance of the animal body undergoes a constant process of renewal.

Flour Milling, American. Flour milling is of two kinds; one the primitive, small industry that supplies a natural local demand; the other a commercial enterprise, which goes into the open markets for its raw material and disposes of its product in the markets of the world. One dates from the early settlement of the country, or as soon as wheat was grown in America; while the other had its beginning about the time of the Revolution, though it assumed no really great importance until after the middle of the last century. While the country has, and probably always will have, a large number of small mills situated in the rural districts, the flour-milling industry proper — considered commercially — is on a larger and more important scale than ever before. In fact, the census of 1900 gives it fourth place among the manufactures of the United States in value of products.

The small mill that supplies a purely local village or rural demand, may properly be termed an "agricultural adjunct." Therefore the history of farming in this country is the history of the grist-mill development. Yet its early growth is of some interest. In 1626, a horse-power mill was built on Manhattan Island, and a windmill in New England, near Watertown, about two years later. Windmills soon became common on the Atlantic coast. The first water-mill in New England was probably built on the Dorchester

side of the Neponset, in 1634. Before the middle of the century, New England was doing an export business, sending wheat and flour to Portugal. In 1649, Virginia had four windmills, five water-mills, and numerous horse-mills, and was also an exporter of wheat and flour. By 1678, New York had a considerable number of mills, and, moreover, had a monopoly on the process of the bolting of flour. The charter was repealed, however, in 1694.

For nearly 100 years following, the development of milling was but the reflection of the growth of the country, with some extension of trade in the West Indies and South America. Still, the process of milling was crude, and the industry, with perhaps a few exceptions, had hardly gone beyond the agricultural or farm-product basis. Not until the mills began to centralize, until "milling centres" began to form, did the industry commence to shape itself on a commercial basis. This period may be said to have commenced shortly after the Revolution. Yet milling then, as compared with to-day, was as the stage coach of 1776 compared with the luxurious express train of the present century. Still, the mills of Delaware, on the Brandywine, were celebrated for their flour. This district had 130 mills within a radius of 40 miles, and Wilmington was an exporter of "superfine" flour.

The next milling centre of importance, and which later became first, was Baltimore. In 1787 the mills of that city made 325 barrels of flour daily, and it was there that the first marked improvements in the process of making flour were adopted. Up to 1785 the different stages of milling were separate and largely done by hand, as they are even to-day in the Hungarian process. But Oliver Evans introduced the elevator and conveyor, and combined the different steps into a continuous system; thus dispensing with much labor, and making a saving in the cost of production. Owing to this improvement and to the slowness of the Delaware millers to adopt it, Baltimore became the more important centre, and the Patapsco River, with its fine water power, became celebrated during the next 50 years. In 1840, the Patapsco, within 30 miles in which the fall is 800 feet, had 60 mills, which ground several hundred thousand barrels of flour a year. A considerable export trade was done with the West Indies.

Still another milling centre was formed at Richmond, Va., at the falls of the James River. The district is now not known as a milling point; the milling business has passed, leaving nothing but a memory of its one-time importance. In 1845, Richmond had the largest mills in the United States, the "Gallego" and the "Haxall." The number of mills there was 21, and their trade besides the local and nearby territory, was with South America. The "Gallego" mills, in 1864, had 31 pairs of buhrs or millstones, with an annual capacity of 190,000 barrels of flour. The "Haxall" mills had a capacity of 160,000 barrels.

From the Atlantic coast the milling centre began its westward march, following the wheat-fields. Rochester, N. Y., in the Genesee valley, was the next centre, and while it retained its importance for many years, it succumbed to newer districts farther to the west. At one time Cincinnati assumed considerable importance as a milling point, but St. Louis was destined to follow Rochester as the centre of a great milling district. While Rochester at the present writing has lost its importance, St. Louis has retained its mills, but has been outclassed by the younger city of Minneapolis. Milwaukee has also developed a slightly greater milling capacity than St. Louis. Thus the milling centre has finally fixed itself, apparently for all time, at Minneapolis. For many years, however, Rochester was recognized as the first milling city of the country, having as early as 1835, no less than 21 mills, with 95 run of stones. The flour from these mills was sold throughout the Atlantic coast States. In 1865, the flour output of Rochester was 800,000 barrels.

With the development of the great central wheat States, mills were built wherever there was increased population. In 1840, Ohio, Kentucky, Indiana, Illinois, and Michigan had a total of 1,200 mills, producing about 30 per cent of all the flour made in the country, yet very few of them belonged to the commercial class, such as those of the centres. The scattered country mills supplied the farming communities and the small towns, while the few larger mills and those of the centres supplied the large markets and the districts where wheat was not raised.

St. Louis began as a milling point in 1840, with two small mills. The city, due to its location, was then the principal point in the West. By 1860, the St. Louis mills were making 800,000 barrels of flour a year. In 1870 the output was over 1,000,000 barrels, and in 1880 over 2,000,000. St. Louis led all other centres until 1881, when Minneapolis began its rapid development. Among the other important milling centres are Toledo, Buffalo, Detroit, Indianapolis, Chicago, Kansas City, and Milwaukee, already mentioned.

A small, crude mill was built at the Falls of St. Anthony, now Minneapolis, by a detachment of soldiers in 1823, but the first merchant-mill was erected in 1854. The first flour was shipped to the east from Minneapolis in 1859. In 1865, the city had six mills, with a total daily capacity of 800 barrels. It was not until 1878 that the total annual output reached 1,000,000 barrels, and the direct export shipments were about 100,000 barrels.

In tracing the movement of the milling centre, it may be of interest to investigate the causes that brought a large number of milling interests together. The importance of the first milling district, the Brandywine, in Delaware, was evidently principally due to convenient wheat supplies. The Patapsco district owed its importance to fine water power, local wheat supplies, and water transportation, while Richmond would probably never have gained any prominence but for its water power, though its transportation facilities, down the James, enabled it to build up an export trade. The fine water power of the Genesee River, at Rochester, was a natural inducement for the miller to build there, while the rich agricultural valley gave an abundant supply of raw material. Then, too, the opening of the Erie Canal gave Rochester unexcelled transportation facilities to other markets. Until other conditions entered into the situation to affect it, Rochester was particularly favored. St. Louis had no water power, but it had river transportation both for wheat and flour, and it was for years the principal distributing point for a vast

territory. Milwaukee was an early wheat market and was the lake outlet for the Northwest before Chicago became a shipping point of importance. It was thus early that mills began to be built at Milwaukee, and its milling importance may be ascribed to its favored position on the lake.

The greatness of Minneapolis as a milling centre is partly due to the water power from the Mississippi River and partly to the position of the city, which is the gateway between the wheat fields and the markets, but it is also largely due to the quality of the wheat of Minnesota and the Dakotas, the greatest spring-wheat territory in the world. Lastly, the pre-eminence of Minneapolis as a milling centre is due to the early business men of genius, who grasped the situation and made the name "Minneapolis" known the world over. Given all the other advantages,— geographical position, water-power, and even the annual production of some 200,000,000 bushels of superb hard spring wheat, — yet without the business genius and enterprise that dominated the early Minneapolis millers, the city might never have been known as the greatest flour-milling centre in the world.

The latest figures at hand show the following flour output at milling centres in the United States for 1902:

	Barrels.
Atlanta	315,000
Buffalo	1,415,300
Chicago	1,300,000
Detroit	567,000
Duluth	1,804,400
Kansas City	1,298,300
La Crosse	435,100
Minneapolis	16,329,800
Milwaukee	1,755,000
New York	1,760,700
Nashville	1,000,000
Philadelphia	301,500
Rochester	402,400
Richmond	218,200
St. Louis	1,625,900
Toledo	1,600,000

The present time may be called a commercial era in the flour-milling industry. The period from 1870 to 1900 might fittingly be termed the mechanical era, for during that time greater changes and improvements were made in the process than in all the 200 years preceding it. During the mechanical period, there was also the export era, when the building of new mills and the increasing output of old ones, together with the increase in wheat raising of the country, caused an over-production of flour, if domestic markets alone were depended upon. In fact, the increased output was to keep pace with the growing export trade. After reviewing the natural development of the milling industry, which up to 1870 was identical with the growth of the country, these three divisions,— the mechanical, the export, and the commercial,— seem most important.

No better review of the mechanical period, up to 1895, can be given that that written by the late Charles A. Pillsbury, of Minneapolis, who did more than any other one man to make the city in which he lived, and the wheat of the Northwest, known in every great market of the world.

In 1895, Mr. Pillsbury wrote:

Down to 1870, the milling process in the United States was that invented by. Oliver Evans, with some minor and gradual improvements. From 1787 the nether and upper millstones, the former stationary and the latter balanced to rotate upon it, ground the flour of America. The stones were set close together, to produce as much flour as possible at one grinding. This produced friction and heat, and often brought about chemical changes which injured the color, taste, and quality of the flour. In the early milling history of Minneapolis, when enterprising manufacturers rushed the speed of the stones to secure a large product, the flour came out dark, and so hot the hand could not be held in it.

Minneapolis spring-wheat flour then stood low in the scale, and was sometimes branded, at the request of buyers, " St. Louis flour from winter wheat." The hard spring-wheat, rich in gluten which made it tough, rendered difficult the separation of flour from bran, and thereby yielded a dark-hued flour which brought a low price in the market. The soft and starchy winter-wheat, on the other hand, yielded readily to the old low-grinding process; the bran was more easily separated, and the flour was lighter in color and less damaged by hard-grinding. The color and quality of spring-wheat flour were somewhat improved in the best mills by a reduction in pressure and speed and by scientific stone dressing; but the main difficulty remained. The difficulty in grinding spring-wheat by the old process was with the middlings, or that part of the kernel between the bran covering and the starchy central body. The middlings, although known to be rich in the gluten which gives wheat-flour its chief value with the baker and pastry-cook, were associated with the bran; and the richer the wheat in gluten, as in case of hard spring-wheat, the more difficult was the process of separation, because the gluten was the cause of the toughness.

The first experiments were made with a view to the purifying of middlings. In 1868, E. N. La Croix, a French millwright, came to Faribault, Minn., and experimented in making a middlings purifier, like one he had seen in France. In 1870 he removed to Minneapolis and continued his experiments. At length a machine was made, and a sample shipment of flour was sent to New York. Word came back by wire that the new flour was selling at 50 cents a barrel higher than other brands. The La Croix machine was crude and in some respects unsatisfactory, and George T. Smith produced a superior machine, different in many points, but retaining the same principle, and obtained a patent.

As a result of the new middlings purification process the mills using it added 50 cents a barrel to their profits in the first year, $1 the second year, and from $2 to $4 per barrel the third and fourth years. Thereupon George H. Christian, representing the Washburn mills, a number of head millers from other mills, and myself, representing the Pillsbury mills, went to Europe and made a thorough study of the Hungarian "high-milling" or gradual-reduction roller and middlings process. As a result some of the Minneapolis mills adopted the Hungarian process bodily, middlings purifier and all, and in a few years were compelled to throw away some of the complex machinery with which they were loaded. The Pillsbury mills, however, adopted only what seemed to be the best features of the Hungarian process, such as the rolls, made modifications all along the line, and retained the American middlings purifier invented by Mr. Smith. We found that the Hungarian system needed simplification to increase its efficiency, to save labor, and especially to avoid dangerous accumulation of mill-dust.

The new and improved high-milling system of Minneapolis and Minnesota thus established made the hard spring-wheat of the Northwest the best flour material on the globe, immediately added 10 to 15 cents per bushel to its market value, and gave Minneapolis flour the first place among the cooks and bakers of the world. By the new process chilled iron and porcelain rolls gradually came into use in place of the old millstones. The grain, in place of being ground in a single pair of millstones, was run through six or seven sets of rolls, being sifted and graded after each breaking by the rolls. The old process aimed to get as much flour as possible at one grinding; the new seeks to get as little flour as possible at the first two or three breakings. The old millstones were set so close together that the weight of the upper stone rested almost wholly upon the grain. The first rolls in the new process are set so far apart that the kernel is simply split for the liberation of the germ and crease. The old process sought to avoid middlings as far as possible, because they entailed loss of flour. The new process seeks to produce as much middlings as possible, because out of the middlings comes the high-grade patent flour. In the handlings of the middlings the new process exhibits the highest art. The gluten, which gives flour its strength or rising power, is saved and made available to the baker, and made a prominent source of profit both to the farmer who raises the wheat, the miller who grinds the flour, the baker who makes the bread, and finally to the consumer, in whom it is transformed into brain and muscle.

With the introduction of the new milling process came the big mills which have made Minneapolis famous, and the development of the spring-wheat industry which has made the Northwest known around the globe. In 1884 there were 23 mills equipped with the new process machinery and possessed of a daily capacity of 30,000 barrels.

The number of mills in Minneapolis has not increased since 1884, although the capacity has been largely increased. In 1884 the output was 5,317,600 barrels of flour, while in 1902 it was 16,329,800 barrels. This increase, without even the enlargement of any of the mill buildings, was due to improved and condensed machines. There are seven milling companies in Minneapolis, having 22 mills with a maximum daily capacity of 75,000 barrels of flour. The capacity of the individual mills is from 600 barrels daily to 15,000 barrels. The Pillsbury "A" mill, having the latter capacity, is the largest mill in the world. Four of the seven companies are small ones, having but one mill each. The mills of the three large companies have a maximum daily capacity of approximately 31,000, 27,500, and 18,000 barrels respectively. The greatest actual weekly flour production was 443,800 barrels, for the week ending 11 Oct. 1902.

Since the discovery of patent flour and the introduction of the rolls, particularly during the last 15 years, the energy and inventive genius of the mill furnishers have been directed toward economy of manufacture, to get the best out of the wheat at the least possible expense. As late as 1900, improvements were made that aided in economy of manufacture, but at this time the limit seems to have been reached in the percentage of high-grade flour that can be produced from the wheat. However, in view of what has been done, one dare not say that still further improvement cannot be made. In this connection a word should be said for patent flour. Much has been written denouncing it as unwholesome and inferior to whole wheat flours; and it has been said that it is over-refined; that the best part of the wheat is eliminated to produce a white flour. All this is without foundation. Chemical analysis and extensive digestive experiments by the United States Agricultural Department prove that white flour bread is not only more easily and completely digested than whole wheat or graham flour bread, but that it contains a greater percentage of the properties that go to nourish the human system. Patent flour is made from the middlings, or that part of the wheat lying between the bran and the starchy central portion of the berry, and it is rich in a high quality of gluten. There is probably no other manufactured article in the world that is sold as cheaply, compared with the cost of the raw material, as is patent flour.

Like the development of milling in this country, the export flour business was not placed upon a high commercial basis until the Minneapolis millers, in the early eighties, began a systematic campaign. From that time until 1900, the export trade increased steadily. Since then some adverse factors, which will be touched upon further on, have arisen. The early mills of the Atlantic coast, as already mentioned, were the first to export flour, probably to meet an actual demand because these mills were the most convenient to buy from, rather than to supply a trade that had been built up by the mills. The early export business doubtless came of itself — a natural demand. The uncertain export flour trade of the first part of the last century reached its climax in the forties, and then, when competition of European mills was felt, dropped off markedly, about the year 1850. During the next 25 years large amounts of wheat were exported annually, while the percentage of the flour production that was sent out of the country was small. The flour trade with the United Kingdom which is now an important part of the export flour business of this country, fell almost entirely away by 1865. This, perhaps, was because the American millers could not hold their own on even terms against the foreign millers, who were then becoming more aggressive and progressive than ever before. The building up of the export flour trade, beginning with about 1875, would make an interesting chapter of commercial history, for this time it was built on a foundation that no fair competition could shake.

The following table, which gives the flour output and the direct export shipments of the Minneapolis mills by years for the last 25 years, will furnish some idea of the development of the export business of the country:

Year	Output Barrels	Export Barrels
1902	16,329,800	3,362,300
1901	15,921,900	3,897,900
1900	15,082,700	4,702,500
1899	14,291,800	4,009,100
1898	14,232,600	4,052,600
1897	13,635,200	3,942,600
1896	12,874,900	3,707,300
1895	10,581,600	3,080,900
1894	9,400,500	2,370,700
1893	9,377,600	2,877,300
1892	9,750,700	3,337,200
1891	7,877,900	3,038,100
1890	6,988,800	2,107,100
1889	6,088,900	1,953,800
1888	7,056,700	2,197,500
1887	6,574,900	2,650,000
1886	6,168,000	2,288,500
1885	5,221,200	1,834,500
1884	5,317,700	1,805,900
1883	4,046,200	1,343,100
1882	3,175,900	1,201,600
1881	3,143,000	1,181,300
1880	2,051,800	799,400
1879	1,551,800	442,600
1878	940,800	107,200

A falling off of the exports will be noticed for 1901, which was true also of the general export business of the country. It was not due to the competition of other countries, but to a discrimination in freight rates, inland and ocean, whereby wheat could be exported cheaper, relatively, than flour.

The table which follows gives in condensed form a clear impression of the importance of the flour industry. Only the merchant-mills are considered. Over 5,000 small grist-mills have been omitted, as they properly belong to an agricultural review rather than to a sketch of milling.

A classification of the merchant-mills of the country for 1900 giving the States having a yearly product of $1,000,000 or over, results as shown in the following table — the second column shows the rank of the States.

The census report of 1900 says of flour milling:

"In order to form a correct idea of the magnitude of the milling industry in any given locality, it will be sufficient to compare with the number of establishments, the capital invested and the number of wage-earners employed. For in-

State or Territory	Rank	No. of mills	Raw Material—Wheat: Bushels	Raw Material—Wheat: Cost	Product—Flour: Barrels	Product—Flour: Value	Average daily product	Average value per barrel	Average bus. wheat per barrel	Average cost per bushel
Minnesota	1	324	102,921,426	$66,641,825	22,705,165	$72,381,659	234	$3.19	4.5	$0.65
Ohio	2	744	35,033,213	24,370,443	7,366,474	26,060,827	33	3.54	4.8	.70
Illinois	3	404	27,566,764	18,382,716	6,078,423	20,813,984	50	3.42	4.5	.67
Indiana	4	592	29,192,680	19,188,538	5,818,392	20,384,714	33	3.50	5.0	.66
New York	5	205	25,232,677	18,432,502	5,434,827	19,928,981	88	3.67	4.6	.73
Missouri	6	593	25,368,939	16,263,077	5,245,421	17,800,204	28	3.30	4.8	.64
Pennsylvania	7	1,185	22,923,795	16,179,063	4,775,166	17,059,265	11	3.57	4.8	.71
Wisconsin	8	313	22,356,963	14,869,326	3,750,253	15,496,295	39	4.13	6.0	.66
Kansas	9	260	23,459,171	13,157,846	5,034,251	15,089,529	65	3.00	4.7	.56
Michigan	10	479	20,121,661	13,855,780	4,012,867	14,899,096	28	3.71	5.0	.69
Tennessee	11	337	16,546,155	11,778,868	3,512,985	13,220,609	35	3.76	4.7	.71
Kentucky	12	336	12,325,621	8,294,690	2,549,947	9,341,759	25	3.66	4.8	.67
Texas	13	96	12,228,132	8,046,610	2,604,554	8,881,359	90	3.41	4.7	.66
Iowa	14	327	12,521,953	7,005,972	2,503,390	8,244,050	26	3.29	5.0	.56
California	15	90	12,786,110	7,649,433	2,660,238	7,952,867	99	2.99	4.8	.60
Virginia	16	317	8,562,519	6,025,314	1,758,946	6,671,815	18	3.79	4.9	.70
Maryland	17	235	7,081,937	4,972,234	1,475,416	5,418,734	21	3.67	4.8	.70
Nebraska	18	242	8,687,731	4,546,481	1,821,107	5,319,911	25	2.92	4.8	.52
Oregon	19	124	8,847,242	4,403,048	1,826,512	4,769,573	49	2.61	4.8	.50
Washington	20	57	8,887,996	4,302,920	1,868,780	4,758,004	109	2.55	4.8	.48
North Carolina	21	551	4,549,396	3,609,061	945,761	4,047 340	6	4.28	4.8	.79
Georgia	22	271	4,136,857	2,880,435	789,191	3,431,754	10	4.35	5.2	70
North Dakota	23	66	4,827,477	2,756,484	1,029,070	3,274,958	52	3.18	4.7	.57
Colorado	24	46	4,869,458	2,716,924	1,012,381	3,063, 00	73	3.03	4.8	.56
West Virginia	25	334	3,813,985	2,680,322	767,160	2,969,298	8	3.87	5.0	.70
Oklahoma	26	30	4,516,858	2,440,518	975,870	2,855,216	108	2.93	4.6	.54
South Dakota	27	80	4,427,426	2,380,818	915,541	2,695,024	38	2.94	4.8	.54
Arkansas	28	158	2,912,566	1,840,529	605,702	2,005,295	13	3.31	4.8	.63
New Jersey	29	119	2,404,670	1,743,080	466,338	1,871,129	13	4.01	5.2	.72
Utah	30	72	2,546,801	1,217,169	513,692	1,413,428	24	2.75	5.0	.48
Total		8,987	481,658,179	$312,632,026	100,823,820	$342,119,777	37	$3.39	4.8	$0.65

stance, in the State of Minnesota, there were 512 milling establishments (including small grist-mills not included in the foregoing table) representing a capital of $24,125,781, and employed 4,086 wage-earners. The average capital invested for each establishment was $47,121, and the average number of wage-earners for each establishment was eight. Compare with this some other locality having approximately the same number of establishments, for instance, Arkansas: the total number of establishments in Arkansas was 410, representing a capital of $1,183,052, the number of wage-earners was 443, the average capital for each establishment was $2,885, and the average number of wage-earners for each establishment was one. Again, in the case of South Carolina, the total number of establishments was 556, the capital invested was $652,553, the number of wage-earners was 281, the average amount of capital invested in each establishment was $1,174, and the average number of wage-earners was only about equal to one for every two establishments in operation."

The following table shows the number of flour-mills having an annual production of 1,000 or more barrels, in States having a cereal mill product of $1,000,000 and over in which wheat flour is the chief product. (Many small mills grind rye and corn principally, and a little wheat):

States and Territories.	1,000 to 4,999 bbls.	5,000 to 19,999 bbls.	20,000 to 99,999 bbls.	100,000 bbls. or more
United States	4,310	2,584	634	135
Alabama	17	3	1	....
Arizona	4	5	1	....
Arkansas	71	34	2	....
California	30	28	11	6
Colorado	12	12	17	1
Connecticut	....	....	....	....
Delaware	27	7	1	....
District of Columbia	....	....	2	....
Florida	....	....	....	....
Georgia	76	9	5	1
Idaho	11	17	4	....
Illinois	129	131	50	12
Indiana	245	235	44	8
Indian Territory	8	12	3	....
Iowa	129	107	21	2
Kansas	73	97	48	13
Kentucky	170	117	17	1
Louisiana	....	....	....	....
Maine	7	1	....	....
Maryland	128	36	6	2
Massachusetts	2	....	....	....
Michigan	236	137	37	4
Minnesota	93	151	52	24
Mississippi	2	....	....	....
Missouri	330	165	44	9
Montana	4	7	4	....
Nebraska	93	110	18	....
Nevada	9	1	....	....
New Hampshire	....	....	1	....
New Jersey	59	27	1	....
New Mexico	19	9	....	....
New York	127	80	23	14
North Carolina	202	36	1	....
North Dakota	23	25	17	1
Ohio	375	282	51	5
Oklahoma	6	14	13	1
Oregon	48	52	13	3
Pennsylvania	556	185	25	5
Rhode Island	....	....	....	....
South Carolina	39	8	1	....
South Dakota	27	55	7	....
Tennessee	209	98	16	6
Texas	23	42	25	6
Utah	42	33	3	....
Vermont	1	....	....	....
Virginia	281	56	12	1
Washington	12	24	16	4
West Virginia	151	20	5	....
Wisconsin	200	103	16	6
Wyoming	4	4	....	....

One of the more recent features of the flour trade has been the considerable business by Minneapolis mills with Australia, the direct result of the crop failure there in 1902. Minneapolis mills also send flour to South Africa, and have

made trial shipments to China, and there is a possibility of a trade being developed in the Far East. Pacific coast mills have introduced their flour in China and Japan, but as yet those countries are not bread-eaters. The northern transcontinental railroads, which will soon connect with an Asiatic steamship line owned by one of the roads, promises to revolutionize some of the native customs. And if China can be induced to become a bread-eater, the export flour business via the Pacific will increase very rapidly.

Commercially, the flour-milling industry has made as great progress as it has mechanically. As the skill of the mill furnisher and the operative miller has separated the best parts of the wheat into a refined and delicate product, yet retained the most wholesome and nourishing properties, as compared with the dark and coarse flour of an earlier milling age, so the work of the merchant miller of to-day differs from that of the miller of the early part of the last century.

Milling is now more a commercial and less a mechanical proposition than ever before. Mechanical perfection has nearly been reached; and it is easier to keep a machine running smoothly than to invent and perfect the machine. Perhaps the greatest commercial problem is that of competition, not only of individual millers, but of nations. It is first a competition for the raw material, and then for the flour trade. Almost every country desires to be a manufacturing nation to some extent, whether a wheat-growing country or not, therefore encouragement is given to home industries. Then, too, Europe buys large quantities of American wheat when the price is low, and later this enters into competition with American flour in foreign markets. Therefore, the flour trade is on a world-wide basis, and the large miller, more than ever before, has great commercial, rather than mechanical, problems to solve. Never, however, will he feel they have all been solved, until the United States exports the surplus of its wheat crop as the manufactured article of flour, rather than a large part of it as raw material.

HENRY L. LITTLE,
Mgr. Pillsbury-Washburn Flour Mills Co., Ltd.

Flour, Wheat, a finely ground meal used for food. Ordinary white or bread flour, of which there are a number of grades, is composed of the interior portion of the wheat kernel subjected to processes of pulverization and purification. In the preparation of white flour either a portion or all of the bran, germ, and other offal parts are removed. When the entire wheat kernel is ground into a meal, it is called graham flour. When a portion of the bran is removed but the germ and fine bran are retained, the product is called purified graham or entire wheat flour.

The history of wheat milling shows that many and gradual changes have taken place since the early times when wheat was pulverized between stones to the present time when it is reduced by steel rolls. Wheat has variously been reduced to flour by means of stone crushers, saddle stones, and stone mortars. The ancient Greeks, Romans, Chaldæans, and Egyptians used saddle stones for grinding wheat into flour, the wheat being placed in a concave stone and rubbed with a convex stone rocked backward and forward. Saddle stones are still in use among the native Africans, and are known to have been used from earliest times. They are also found among the remains of the prehistoric Swiss lake-dwellers and mention is made of them in the earliest literature. Their use appears to have been common among all primitive races and they are in use to-day by many barbarous and half-civilized nations. Near the beginning of the Christian era, querns or crude crushers in which the parts were fitted mechanically came into use. The upper stone or pestle revolved upon the lower concave stone. The quern was the forerunner of the millstone. Querns are still in use in some Asiatic and European countries. The millstone came into use about the 14th century and was the result of gradual evolution from the stones shaped by nature and operated by hand to specially hewn and dressed millstones propelled by various forms of motive power. In ancient times, flour was prepared in each household, the grinding being done by women, slaves, and menials. During the Middle Ages when the feudal system was at its height, crude flour-mills or querns formed a part of the outfit of each castle or estate. In some countries, the right to operate these mills was vested in the clergy, and in early English history frequent mention is made of contests between the people and the landlords and clergy relative to their right to operate these mills or querns.

Until the beginning of the 17th century wheat milling was simply a crude agricultural industry, the earlier mills being operated by slaves, then by oxen. Later water wheels and windmills were used as motive power. About 1820, a flour-mill was first operated by steam. At the present time, some mills are operated by electric power.

About 1870 the present roller process of flour production was introduced from Hungary into America. The process consists of the gradual reduction or pulverization of the floury portions of the wheat kernel between corrugated and smooth steel rolls and of the purification of the product by means of aspirators, sieves, and bolting cloths. During the process of milling, the granular middlings undergo gradual reduction and are passed from break to break. At each break or grinding, the fine flour is removed by bolting, the middlings are separated and passed to other rolls and the tailings are subjected to further reduction. Before passing to the rolls, the wheat is screened to remove loose dirt and weed seeds, and occasionally washed to remove adhering dirt and debris; then dried or tempered with steam, as may be necessary in order to more easily effect reduction. The first break simply flattens the kernels after splitting them in halves along the longitudinal groove. The germ is pinched off by the rolls and is readily separated. The flour passes automatically from one break or set of rolls to another. Each break is regulated so as to pulverize a little finer than the preceding one. Each stream is purified by passing through reels and by subjection to aspirators which remove the fine dust and dirt by suction. Finally the various streams are blended so as to form different grades of flour. In large mills, the cleaned wheat is usually elevated to the top of the mill, and then passed on to the rolls, and the various

streams blended in such a way that the final flour product is obtained after being separated into 40 or more separate streams.

The introduction of the roller process of miling has made it possible to use varieties of wheat from which high-grade flour could not be made by the old stone process. By the roller process of reduction, the granular middlings which were formerly excluded from the flour and sold as a distinct product for animal feeding are now reduced and added to the patent grades of flour. About 75 per cent of the cleaned wheat is returned as merchantable flour, 72 per cent being straight grade or ordinary white flour. In ordinary milling, the grades are as follows: (1) first patent; (2) second patent; (3) straight, sometimes called standard patent; (4) first clear; (5) second clear; (6) red dog. First patent flour is the highest grade manufactured. Its gluten has greater power of expansion and absorbs more water than that from any other grade. First patent flour produces the whitest and largest sized loaf of bread. Second patent flour is similar to first patent, but the bread is slightly darker in color and the gluten does not possess quite so high a power of expansion. First clear grade flour is obtained after the removal of the first and second patent grades. This flour is slightly darker in color and produces a smaller sized loaf than the patent grades. Second clear or low grade is the name given to a small amount of flour obtained after the removal of the first clear. About 12 per cent of the cleaned wheat is recovered as first clear flour and about .5 per cent as second clear or low grade. When the wheat is milled so that the first and second patents and the first clear are all obtained as one flour, the product is called straight grade. This is the flour that is most extensively used for bread-making purposes. Straight flour is the sum of the first and second patents and the first clear. The lowest grade of flour manufactured is called red dog; it is dark in color and possesses but little power of expansion. It is secured largely from those portions of the wheat kernel adjacent to the germ and aleurone layers. Red dog flour is not generally used for human food, but is employed in the arts, as for foundry purposes, for the feeding of animals and occasionally in the preparation of some cereal breakfast food. It has a high per cent of protein or nitrogenous material, but is not valuable for bread-making purposes because the gliadin and glutenin (see Bread and Bread Making) are not present in the right proportions to form a balanced gluten. By blending the different standard grades of flour, various commercial grades sold under different trade names are secured. The composition and properties of different kinds of flour result from the kind of wheat used in preparation (see Wheat) and the method of milling employed. The percentage amounts of bran, shorts, and standard grades of flour obtained by the roller process vary with different kinds of wheat. Some wheats yield more flour than do others. The average yields are approximately as follows:

	Per cent of cleaned wheat recovered
1. First patent	56.0
2. Second patent	60.8
3.* Straight or standard patent	72.6
4. First clear or first bakers	11.8
5. Second clear or low-grade	0.5
6. Red dog	1.9
7. Shorts middlings	11.6
8. Bran	13.4

*Straight grade flour is composed of first and second patents and first clear grade.

By the roller process of milling, the germ is excluded because of its poor bread-making properties and its fermentable nature. The wheat offals of which shorts and bran form the main portion are by-products used for the feeding of animals. About 25 per cent of the cleaned wheat finds its way into the offals. Bran is the episperm or outer covering of the wheat kernel. As human food, it is indigestible and does not contain any appreciable amount of available nutrients. As an animal food, however, it has a high value. Shorts consist mainly of the fine bran mixed with some of the floury portions of the wheat kernel. When the wheat screenings, consisting of weed seeds and other refuse are ground and mixed with the shorts, the product is known as shorts feed. When the germ is mixed with the shorts, the term shorts middlings is used. By some processes of milling, the germ is obtained separately. From 5 to 7 per cent of the weight of the cleaned wheat is recovered as germ.

Wheat flour is composed of starch, gluten proteids, water, fat, ash, or mineral matter, and small amounts of other compounds, as sugars, cellulose, organic acids, amids, etc. The proximate composition of the different kinds of flour when milled from the same lot of hard wheat is given in the following table:

	Water, Per Cent	Protein (N x 5.7) Per Cent	Fat Per Cent	Carbohydrates Per Cent	Ash Per Cent	Phosphoric Acid Per Cent	Acidity Per Cent	Heat of Combustion per Gram. Determined. Calories
Wheat	8.50	12.65	2.36	74.69	1.80	0.75	0.18	4.140
First patent flour	10.55	11.08	1.15	76.85	.37	.15	.08	4.032
Second patent flour	10.49	11.14	1.20	76.75	.42	.17	.08	4.006
Straight flour	10.54	11.99	1.61	75.36	.50	.20	.09	4.050
First clear grade	10.13	13.74	2.20	73.13	.80	.34	.12	4.097
Second clear grade	10.08	15.03	3.77	69.37	1.75	.56	.27	4.267
Red dog flour	9.17	18.98	7.00	61.37	3.48	....	.59	4.485
Shorts, middlings	8.73	14.87	6.37	65.47	4.56	....	.14	4.414
Bran	9.99	14.02	4.39	65.54	6.06	2.20	.23	4.198

From the table, it will be observed that there is a gradual increase in the amount of ash, proteids, and fat from the first patent flour to the red dog or lowest grade of flour. In fact, the variations in ash content of the different grades of flour are so regular that the percentage of ash can be taken as an index to the grade of flour. The highest grade flours, as first patent, contain least ash because of the more perfect exclusion of the bran and endosperm parts. There is but little difference in chemical composition between the first and second grades of patent flour, second patent, containing more fat, slightly more protein and germ, and less carbohydrates than first patent. In the straight grade or ordinary bread flour, there is only from .6 to .7 per cent less nitrogenous material as

proteids than in the wheat from which it was milled. Second clear and red dog flours contain a large amount of protein, fat, and ash, and judged by their proximate composition only, would appear to have a higher nutritive value than the patents or straight grade flours. But when judged on the basis of digestibility, available nutrients and physical character of the bread, these flours are found to have a much lower value than the patents or straight grade flours. For nutritive values, see article on BREAD AND BREAD MAKING. During the process of milling, the flour particles pass through bolting cloths containing from 12,000 to 16,000 meshes per square inch, which results in even and fine granulation of the flour particles. The character of the flour particles as angular or spherical depends largely upon the character of the wheat, as hard or soft, and to a less extent upon the method of milling. The flour granules from hard wheat are angular and have a sharp feeling akin to fine sand, while soft wheat flours produce small spherical particles lacking in gritty feeling.

In the testing of flour, particular attention is given to physical characteristics, as color, purity as indicated by absence of dirt and fine pieces of bran, capacity to absorb water, quality of gluten and character of the bread product. For bread-making purposes, the quality of the flour depends largely upon the amount and quality of the gluten. The gluten is obtained by making a stiff dough of the flour and then washing this dough with an abundance of water, which removes the starch, leaving the gluten in the form of a gum-like mass. Gluten from high-grade flours is firm, elastic, white or of slightly yellowish tinge and possesses good qualities of expansion. Poor gluten is dark in color, sticky and lacking in elasticity. The color of the flour depends largely upon the quality of the wheat and the method of milling employed. Some wheats produce creamy or yellowish flours, others chalk white flours and others dark-colored flours. Dark-colored flours, however, produce bread of inferior quality; creamy and white flours producing the best grades of bread. The granulation of the flour is also taken as an index of its quality, as it reveals to the experienced miller and baker the character of the flour. Comparative baking tests are generally resorted to in order to determine the bread-making value of flours. By these tests, under uniform conditions with the same amount of flour, yeast, water, etc., in each case, differences in the bread-making qualities of the flour are readily revealed. When flour is stored for a long time, it sometimes becomes inferior through fermentation changes. Ordinarily, flour will not deteriorate until after it has been kept for 10 months or more. Some wheats produce flours of better keeping qualities than do others. The soundness of the wheat, as freedom from rust, smut or other blemishes, influences the keeping qualities of flour as well as does also the process of milling, particularly the extent to which the cleaning and purification are perfected.

Wheat flour is not ordinarily adulterated, although at times attempts have been made to add other cereals and mineral adulterants. The national flour law requiring all mixed flours to be branded has prevented extensive adulteration. At one time, corn flour produced by milling corn, was used for adulterating wheat flour. This, however, was only practised for a very short time when corn was cheap and wheat was high in price. The blending of wheat and corn flours has never proven successful and the practice since the passing of the national flour law has been discontinued. Wheat flour appears to be less subject to adulteration than many other articles of food. See ADULTERATION.

Wheat flour is used not only for bread making but for other purposes. Crackers, cakes, pastry and many food articles are made largely of flour. Flour is also used in the arts and industries and in various manufacturing operations. The comparative value of bread made from different kinds of flour, as graham, entire wheat and straight, is discussed in the article BREAD AND BREAD MAKING.

It is estimated that four and a half bushels of wheat, equivalent to about 200 pounds of flour, are consumed annually per capita in the United States. The consumption of flour as food has, during recent years, gradually increased. Some political economists and scientists have feared that at no distant date the consumption of flour would exceed the production of wheat. But improved methods of agriculture and the opening up of large tracts of land suitable for wheat culture, as in northwestern Canada, render this improbable. From earliest times wheat and wheat flour have taken an important part in the dietary of man and there is every reason to believe that it will continue to be one of his staple articles of food. The extent to which it should be used in the dietary depends largely upon the individual and the cost of food. Ordinarily wheat flour is one of the cheapest articles of food, and when it forms a part or even the main portion of a ration, it supplies a large amount of nutrients in a digestible form and at a low cost.

HARRY SNYDER,
Professor of Agricultural Chemistry, University of Minnesota.

Flow'er, Benjamin Orange, American editor and author: b. Albion, Ill., 19 Oct. 1858. He was for some years the publisher and editor of the 'Arena' at Boston. Among his numerous works are: 'Civilization's Inferno; or Studies in the Social Cellar' (1893); 'The New Time' (1894); 'Persons, Places, and Ideas'; 'Gerald Massey: Poet, Prophet, and Mystic' (1895); 'The Century of Sir Thomas More' (1896); 'Lessons Learned from Other Lives.'

Flower, Frank Abial, American historical writer: b. Cottage, N. Y., 11 May 1854. Has written several local histories: 'Old Abe, the Wisconsin War Eagle' (1880); 'The Life of Matthew H. Carpenter' (1883); 'History of the Republican Party' (1884).

Flower, Roswell Pettibone, American financier: b. Jefferson County, N. Y., 7 Aug. 1835; d. Eastport, Long Island, 12 May 1899. He began his business and political career in Watertown, N. Y., where he organized the Jefferson County Democratic Club. His success in politics attracted the attention of Samuel J. Tilden, through whose influence he was appointed chairman of the Democratic State Committee in 1877. Four years later he was elected to Congress, and in 1886 was appointed president of the Subway Commission. He was re-elected to Congress in 1888 and 1890, and in 1891 was elected governor of New York. From the close

of his term till his death he applied himself to the interests of his large banking house and to a systematic course of philanthropy.

Flower, Sir **William Henry,** English zoologist: b. Stratford-on-Avon 30 Nov. 1831; d. London 1 July 1899. After a medical training he served as an assistant-surgeon in the English army during the Crimean war; in 1861 was appointed conservator of the museum of the Royal College of Surgeons; and in 1870 Hunterian professor of comparative anatomy in the same institution. In 1884 he was appointed director of the natural history departments of the British Museum, which two or three years before had been removed to their new quarters at South Kensington. From this post he retired in 1898. In 1889 he was president of the British Association meeting at Newcastle-on-Tyne. He was made a knight commander of the Bath in 1892. Several important treatises came from his pen, including 'Introduction to the Osteology of the Mammalia' (1870, 3d ed. 1885); 'Fashion in Deformity' (1881); 'Introduction to the Study of Mammals, Living and Extinct' (1891); 'The Horse: a Study in Natural History' (1892); and 'Essays on Museums and other Subjects connected with Natural History' (1898).

Flower, that part of the spermatophytous (phanerogamous) plant which consists of the organs of reproduction, frequently, but not necessarily, accompanied by protecting envelopes. In common usage, the word "flower" is applied to those related structures only in which one or both sets of floral envelopes are present and rather conspicuous.

Parts: Their Position and Functions.— The end of the flower stalk upon which the parts of the flower are grouped is known as the torus or receptacle. In a complete flower the floral envelopes are double, composed of two whorls or circles, alternating with each other; the outer series consisting commonly of green or greenish leaves named sepals, and together forming the calyx; and the inner series, of leaf-like parts, usually of a delicate texture, and of some other color than green, named petals, and together constituting the corolla. The term perianth is sometimes applied to the floral envelopes taken together, but it is generally restricted to those flowers in which only one of the series is present, at least in appearance, as in the lily, and in the common marsh-marigold; or in other instances where the limits of the calyx and the corolla are not easily distinguished. The organs of reproduction are the stamens, or fertilizing organs, forming a whorl within the floral envelopes and known collectively as the andrœcium; and the pistils at the centre of the flower, containing the ovules or undeveloped seeds, and known as the gynœcium. The essential part of the stamen is the anther or pollen sac, having usually two cells attached by a connectile to one another and to the stalk, called a filament, at the summit of which they are placed. The insertion or place of attachment of the stamens varies. In the lily, the buttercup, and the marsh-mallow the stamens are seen to arise directly under the gynœcium, and are accordingly described as hypogynous; in the strawberry and cherry they arise in a higher circle and upon the calyx and are termed perigynous; while in the iris, the rose, and blueberry they are inserted upon the top of the ovary, and are said to be epigynous. (Plate I., Figs. 3, 4, 5.) In the absence of the filament the anther may be sessile on the receptacle, calyx, petals, or ovary, or be adherent to the style (as in *orchis*). The essential parts of the pistil are the ovary and the stigma. The former is the rudimentary seed vessel. The latter, which is intended to receive the pollen upon its viscid surface, is connected with the ovary by a stalk known as the style, or is sessile upon it, as in the poppy. The pistil may be formed of a single carpel or of a number of carpels united by their lower parts to form a compound pistil. The number of carpels represented in such a pistil may be determined by the number of styles; by the number of free stigmas (though a single carpel is sometimes accompanied by a two-lobed stigma); by the seams, lobes, or angles of the ovary; by the cells, by the character of the placenta, or ovule-bearing portion of the carpel. The ovules, or rudimentary seeds, are borne upon the inner or ventral suture formed by the united edges of the carpellary leaf constituting the seed-vessel. In a "compound" pistil the single carpels may be closed, as in a "single" pistil, and joined at their sides and ventral sutures; or they may be open and joined by their edges. In the first case there will be in the compound ovary, as many cells as there are carpels, and the placentæ will meet at the axis. In the second there will be but one cell and the placentæ will be parietal. There are, however, many intermediate conditions, as in the poppy where the inflected margins of the carpels carry the placentæ to the centre. The apparent anomaly of a free axial placenta in the single cell of a compound ovary is found in the purslanes and in the pinks. The delicate partitions or dissepiments have very early disappeared. The ovules vary in number from one to hundreds. They are sessile or borne on a stalk called the funiculus. In direction they are horizontal, ascending (pointing obliquely upward), erect from the base of the cell, pendulous from near the top of the placenta, or suspended from the summit. The ovule-body is surrounded by an integument of one or two coats, which does not meet at the summit. The minute opening thus left is known as the micropyle. Within the ovule-body is the embryo-sac, which contains the endosperm and one or more germ-cells. The simplest form of pistil is that of the gymnosperms, which consists of open scales bearing two or more ovules on the inner face next the scales.

The chief function of the calyx is protection, an office which it shares with the corolla, especially while the more delicate organs are in the bud. When the corolla is lacking, the calyx frequently assumes some of its characteristics, becoming more conspicuous and of finer color and texture, the marsh-marigold and purple clematis furnishing examples in point. The bright hues or markings of the corolla serve to attract the insects that play such an important part in the pollination of the flower. The andrœcium has for its function the producing and scattering of the fructifying pollen, which falls from the anthers when they open at maturity. The gynœcium is devoted to the development of seed from the ovules.

Evolution of the Flower.—The recognition of the flower as a modification of the stem and leaves, adapted to the purposes of reproduction, gives a key to its morphology, throwing light on

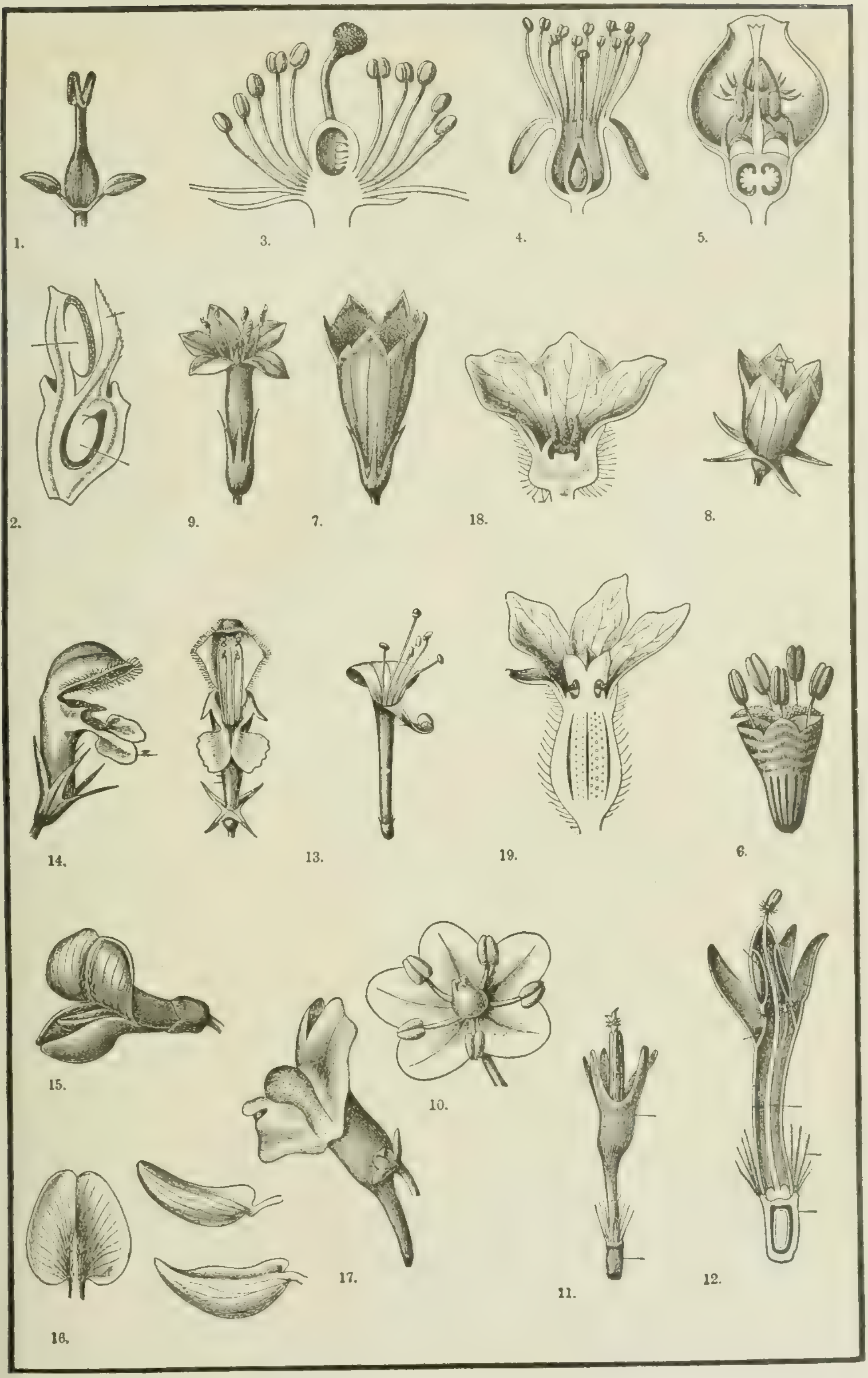
innumerable variations of arrangement and structure and even on such details as scent, color, and the production of nectar. This conception of the flower was of fundamental importance in the transition from the artificial to the natural system. The shortening of the axis aggregates the transformed leaves and a growth is produced in which the arrangement of the true leaves on the stem is still the regulating principle, whether there be an alternating succession or a whorled (cyclic) grouping, the more developed flowers following the latter order, with limited number of parts, generally definite for certain large groups. Flower buds, like leaf buds, are terminal or axillary. The prefloration or æstivation of the sepals and petals, individually considered, is similar to that of leaf buds, being convolute, revolute, or involute. The metamorphosis of the leaf is easily traced in certain flowers. In the peony the transition from leaves to bracts and thence to petals is gradual, as is the change in the sweet-scented shrub (*Calycanthus*) from sepals to petals. In the white water-lily the gradations between the pistil and stamen are finely illustrated. It does not follow that the order of development is from the former to the latter. That the essential organs are of earlier origin than the floral envelopes is indicated by the fact that the latter are wanting in the gymnosperms, which are older and less developed forms than the phanerogams (spermatophytes). In the anther we recognize the infolded leaf-blade, in the filament its petiole, and in the pollen a development from the parenchyma. In the pistil the carpellary leaf may be traced, with its lengthened apex forming the style. The double-flowering cherry offers an interesting example of the reversion of the pistil to the form and color of the true leaf. The interpretation of the ovule as a transformed bud upon the edges of the carpellary leaf is confirmed by the fact that the leaves of *Bryophyllum* and certain other plants produce buds upon their margins or upper surface. Even the stipule of the leaf has its homologue in the floral structure. What is called the outer calyx or epicalyx of the strawberry may be regarded as the united stipules of adjacent sepals. That portion of the stem which becomes the floral axis sometimes undergoes striking modifications in its function as a receptacle. In the wild geranium it is extended into a slender beak, while in the rose-hip it becomes urn-shaped. The fig and the strawberry are succulent receptacles, the one hollow and the other convex. In investigating the morphology of the flower it was formerly the method of botanists to start from an ideal type and to consider as mere modifications of that type all forms that differed from it. A later view admits the probability of various independent lines of development. Those types are the simplest in which the floral structure is nearest to the original arrangement, the parts being more definitely separated. Union of parts indicates as a rule greater complexity of type, though simplicity of structure may in some cases be an indication of degeneration. Simplicity of type is illustrated by the water-lily family (*Naiadaceæ*), and complexity by the orchids (*Orchidaceæ*) and the thistle family (*Compositæ*).

Although the morphology of the flower continues to be of paramount importance in the classification of plants, the application of the principles of evolution to the study of botany has inevitably led to a method differing from that formerly in use. The 24 classes into which Linnæus divided plants were (with the exception of the cryptogams) based on the length, number and other characteristics of the stamens; and the classes were divided into orders chiefly according to the characteristics of the pistil. In the system worked out by the French botanists and known as the "natural" system stress was laid upon the characteristics of the perianth, the presence or absence of a corolla and the union or separation of petals. In a system based on the facts of development the fundamental division into monocotyledons and dicotyledons may still be maintained, though late methods do not recognize the likeness existing between adult forms as sufficient to place them in the same group, classification proceeding rather on the principle that relationship is more convincingly shown by similarity in manner of reproduction and in laws of growth.

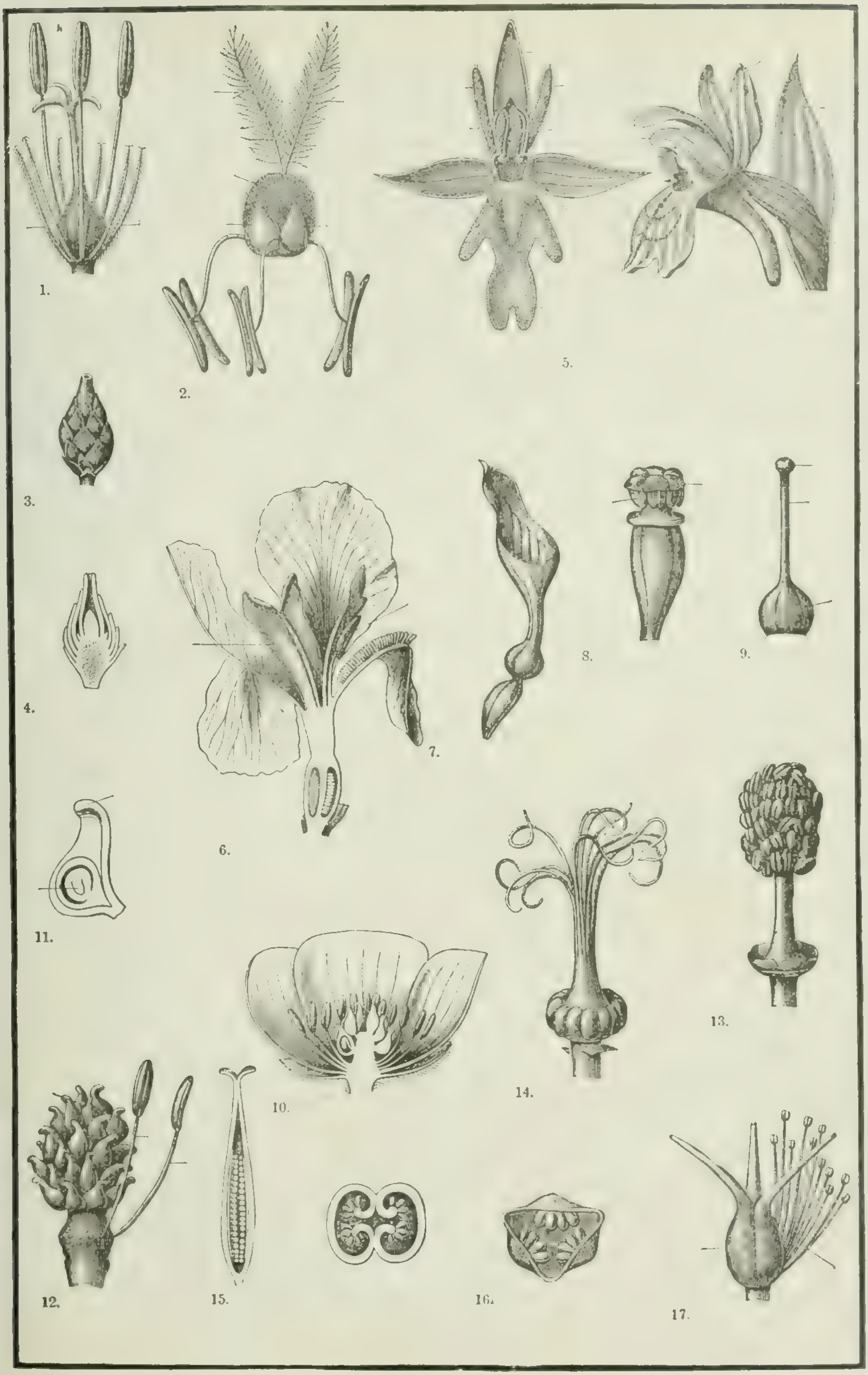
Variation in Structure and Arrangement.— Flowers are said to be perfect when they are provided with both kinds of essential organs; complete when calyx and corolla are also present; regular when all the parts of each set are alike in shape and size; and symmetrical when they have an equal number of parts of each kind. In the monocotyledons the parts are in threes; in the dicotyledons mostly in fives or fours. The perianth of the lily, though apparently having six in a set, has really three sepals and three petals, as is plainly shown in the bud. Apparent violation of the law of symmetry may in certain cases be due to adhesion, abortion or non-development of floral plants. In the mustard family, though the calyx and corolla are in fours, the stamens are generally six. The suppression of two stamens would account for lack of symmetry. An instance of non-development is found in the monkshood, where the sepals number five and the petals two, while three very minute rudimentary petals are sometimes discernible. The violet, although symmetrical as to sepals, petals, and stamens, which are in fives, has a simple stigma and three-valved seed-vessel. The flax is a good example of a symmetrical and regular flower. The irregularity of the flower may be shown in any of its parts, but is most striking in the peculiar forms often assumed by the corolla and calyx, most curious instances being seen in the orchids, a family in which the morphology of the andrœcium and gynœcium are also of especial interest.

Certain variations of form may be traced to the visits of insects, as where such a visitant alighting always on the same side of the flower tends by its weight to increase the size of that part or to thicken the tissue, etc. The chief irregularity of some corollas consists in having one or more spurred petals. This deviation from the ordinary petal shape is common and sometimes serves the purpose of providing flowers with nectaries, as in the case of the violet, the toad-flax, and the columbine. In the nasturtium it is the calyx spur that constitutes the nectary. Less noticeable modifications in the petals of other flowers have the same function, as the scales on the petal-claws in the crowfoots and the pits in the petals of lilies and fritillaries. The irregularity illustrated in the blossoms of the pea and the bean is of a very common kind. This butterfly or papilionaceous corolla marks

MORPHOLOGY OF FLOWERS.—I.



1. Ash flower. 2. Section of flower of Hippuris. 3. Hypogynous flower (sun-rose). 4. Perigynous flower (cherry). 5. Epigynous flower (whortleberry). 6. Flower of Elm. 7, 9. Funnel-shaped corollas of Gentian. 8. Bell-shaped corolla 10. Rotiform corolla. 11. Tubular corolla (bluebottle). 12. Sections of bluebottle. 13. Two-lobed flower. 14. Labiate flower. 15. Papilionaceous corolla. 16. Parts of a papilionaceous corolla. 17. Personate corolla (spurred). 18. Male (staminate) flower (melon). 19. Female (pistillate) flower (melon)



1. Hypogynous bristles of Bulrush. 2. Hypogynous scales of Grass. 3. Flower of the Yew. 4. Section of the same. 5. Perianths of Orchids. 6. Iris. 7. Aristolochia. 8. Fruit of Aristolochia, showing sessile anthers. 9. A single pistil. 10. Section of Ranunculus. 11. A single carpel of Ranunculus. 12. Gynœcium of Ranunculus. 13. Andrœcium with united filaments. 14. Gynœceum with united carpels. 15. Ovary of Gentian with two united carpels. 16. Ovary of Violet with three united carpels. 17. Gynœceum of Hypericum with a part of the stamens.

the family to which these legumes belong. In the case of gamopetalous (sympetalous) corollas it is convenient to speak of the parts of the more primitive or separated type as having coalesced, even if the growth be regarded as undivided from the beginning. The regular five-petaled corolla has its homologue in such a gamopetalous corolla, as that of the campanula (Plate I., Fig. 8), where the five lobes correspond to the separate petals and maintain the numerical scheme of the flower. The labiate or bilabiate (two-lipped) corolla is the characteristic form of the mint family (*Labiatæ*), and of the figworts (*Scrophulariaceæ*), the ringent or gaping corolla of the dead-nettle (Plate I., Fig. 14) and the personate corolla of the snapdragon and toad-flax being variations of the type. Not only is a union of parts frequent in the corolla and the calyx, but it has its counterpart in certain forms of the andrœcium and the gynœcium. The filaments of the lupine arise as a single cylindrical growth and the syngenesious anthers of the *Compositæ* are a pre-eminent characteristic of that large family. The combination of several carpels to form one pistil has already been referred to, complete union being found in the rhododendron among other instances, and the gynœcium takes a great variety of forms according to the degree of distinctness maintained by the separate parts of the contiguous carpels.

Fertilization.— Flowers which are achlamydeous, that is, destitute of floral envelopes, may be unisexual or bisexual (androgynous). The male (staminate) flowers and the female (pistillate) flowers may be found upon the same plant, which is then termed monœcious, the alder, oak, ragweed and begonia being examples; or the staminate flowers of a species may be produced by one plant and the pistillate by another, the plants being then diœcious, as in the willow family (*Salicaceæ*). The neutral flower is one lacking both kinds of essential organs, as is the case with the ray flowers of many *Compositæ*. The showy snow-ball tree and the garden hydrangea are examples of development of such flowers by cultivation, the neutral flowers being found only on the margin of the flower cluster in the wild species. Close fertilization, that is, the fertilization of a flower by its own pollen, is rendered impossible by the unisexual arrangement, but so long as the transfer may be from flower to flower on the same plant the advantages of cross-fertilization strictly so-called (that is, from plant to plant) are not positively insured. Diœcious flowers might be expected to prove better producers of seed, as close fertilization would naturally be looked for in bisexual flowers, and indeed was formerly considered the normal method, but it is doubtful if there is any species of which it could be proved that its flowers are without exception self-fertilized. By the dichotomy of some species of bisexual flowers (that is, by a difference in the time when the essential organs mature) the pollen is set free before the stigma is ready for pollination, the latter being accordingly obliged to rely upon pollen from without. In other cases the structure of flowers is of such a nature that fertilization by their own stamens is guarded against.

Agencies for the transportation of pollen are various. Flowers dependent upon the wind, like those of the date-palm, are known as «anemophilous»; those for which insects are the carriers are «entomophilous.» (See FLOWERS AND INSECTS.) Many plants bear two kinds of blossoms, conspicuous, nectar-producing flowers, which are entomophilous, and inconspicuous, later-blooming blossoms in which close fertilization takes place. Certain species of violets have the two forms, their later flowers never opening nor developing petals, but becoming fertilized in the bud. Contrary to the law which generally controls fertilization, these cleistogamous blossoms are more fruitful than those on the same plant open to cross-fertilization. Whatever be the method of pollination, the pollen-grain when it falls upon the stigma absorbs the moisture of the surface and germinates. It then sends down a tube which passes through the tissues of the style and stigma and on reaching the cavity of the ovary enters the micropyle and penetrates to the embryo sac. Sometimes the latter has grown out to the micropyle, or even through it, to meet the pollen-tube. The chalaza, or point of attachment of the ovule, is in a few instances the place of entrance for the pollen-tube. The transfer of the contents of the pollen-tube to the germ-cell in the embryo sac takes place, thus fertilizing the cell, which begins to grow and divide, developing the embryo plant, at first nourished by the endosperm, or albuminous contents of the sac.

Colors of Flowers.— The colors of flowers have been arranged in two series, the blue and the yellow, in both of which red and white are found, green being produced by a blending of the two. It has been estimated that in an average collection of 1,000 plants about 284 have white flowers, 226 yellow, 220 red, 141 blue, 73 violet, 36 green, 12 orange, 4 brown, and 2 black. White flowers are more generally odoriferous than those of other colors, and their odors are almost always agreeable. Red flowers, though less numerous than yellow ones, are more often fragrant. The tints are due to fluid or viscous matters contained in superficial cells and can be separated in certain cases by solution in water and in others by solution in alcohol and ether. Attempts have been made to refer the coloring matters to one or two principles, which have been described under the names of xanthin, xanthein, anthoxanthin, and cyanin and anthocyan. These bodies, however, are very ill defined and are in all probability mixtures, even supposing that when obtained from different sources they are essentially the same. The chief difficulty is to obtain the coloring matters in sufficient quantity for investigation and then to separate them accurately from each other which, as they are amorphous, uncrystallizable bodies, is not easy to accomplish satisfactorily. Of the coloring matters from flowers one of the most individualized is the yellow body obtained from saffron. See BOTANY; FLOWERS AND INSECTS; FRUIT; GARDEN; INFLORESCENCE; SEED.

Flower Beetles, scarabeid beetles of several genera. One of the most abundant and destructive of these insects is the rose-chafer (q.v.), which annually does great damage to roses and other flowers and fruits. Several species of the genus *Euphoria,* more especially *E. inda,* is frequently found on flowers eating pollen, but it also attacks corn in the milk, and eats into various forms of fruit. Other flower beetles belonging to the genera *Hoplia* and *Trichius* are commonly found on flowers through-

out the country and take some part in the cross-fertilization of useful plants. Numerous other beetles frequent flowers, among which are beautiful species of the genera *Clerus* and *Trichodes* of the *Cleridæ; Leptura* and many related genera of long-horned beetles; and many genera of small families such as the *Mordellidæ*.

Flower-bug, a very minute bug (*Triphleps insidiosus*) also called "insidious flower-bug," and related to the bedbug. It is found on the foliage of various plants, and preys upon other minute insects.

Flower Month, in general any month in any country in which flowers are springing most abundantly; in the United States, June is specially the month of flowers. Specifically, the month Anthesterion, the eighth of the Attic year, corresponding nearly to February; so called because that time was, in that country, the season of flowers.

Flower-peckers, general name for a large family (*Dicæidæ*) of small insectivorous birds allied to the creepers (q.v.) which get their food largely by searching flowering plants and their blossoms, picking up minute insects largely by aid of a curious tongue which is separated at the end into four tubular projections. They inhabit the Indo-China region and thence throughout the archipelagoes to Australia, where the white speckled diamond-birds (*Pardalatus*) and the swallow-dicæum (*Dicæum erythrorhynchum*) are familiar friends of the gardener. They frequent bushes and trees, hopping briskly about the branches, and creeping and clinging like titmouses. Some make extremely beautiful, highly decorated nests, while others are content to deposit their eggs, which in most of the species are white, in holes in trees, or earthen banks, or old birds' nests. Some are plainly dressed, but most of the flower-peckers are gaudily colored, and several sing sweetly.

Flowering Ferns. See *Filicales* (1), under Ferns and Fern Allies.

Flowers, in chemistry, a term formerly applied to a variety of substances procured by sublimation in the form of slightly cohering powder, hence in all old books we find mention made of the flowers of antimony, arsenic, zinc, and bismuth, which are the sublimed oxides of these metals in a more or less pure state. We have also still in use though not generally the terms flowers of sulphur, of benzoin, etc.

Flowers and Insects: Their Relations. In order to appreciate the intimate relations between flowers and insects we should bear in mind the fact that in all probability the earliest plants known were flowerless, and that the earliest known insects never visited flowers. The most primitive reproductive parts of plants were minute structures, simply greenish, and without colors. From the cryptogamous plants somehow arose the flowering plants, and when flowers did appear, they were of regular shape, with the corolla made up of separate petals; then finally appeared the irregular flowers like those of the monkshood, the pea, bean, wistaria, etc. The simpler forms of flowers were those of the grasses. Such plants are fertilized by the wind, but in the higher modern flowering plants the floral organs are fertilized by insects. What attracts insects to flowers, and thus causes them to carry the pollen from the stigmas to the pistil? Is it the nectar or the odor given out by the flower, or the colors of the petals?

Insects Attracted by the Sweets of Flowers. — According to Darwin, Lubbock, and others, the brightly colored petals of flowers are necessary to attract bees, butterflies, moths, beetles, etc. Thus the petals of many flowers are beautifully marked with highly colored hues, which are thought to be "guiding lines," by which the bee was guided to the nectary at the bottom of the flower. But this view has been called in question by a Belgian naturalist, Plateau. To test the matter Darwin and others had removed the petals, or corolla, and watched to see whether insects continued to visit the flower, but this, owing to want of care in removing the petals, had led to contradictory results. Plateau experimented more carefully; he avoided handling the flowers, or doing anything which might influence an insect's sense of smell. He removed the brightly colored corollas from the flowers of lobelia, ipomæa, larkspur, foxglove, etc., and in every case, except that of *Antirrhinus majus*, the mutilated flowers were observed to be freely visited by various kinds of insects (bees, bumblebees, syrphus flies, and an occasional butterfly), no special preference being exhibited for flowers that were left intact. The insects not only sucked honey from the mutilated flowers, but they often circled around them without alighting. In the case of the snapdragon, several bumblebees hovered around the mutilated heads but afterward left them for those with entire flowers, a result explained by the peculiar mode in which bees have to enter the corolla, which would render the absence of that structure perplexing to them. Plateau covered several of the large umbels of Hieracium with rhubarb leaves, when it was found that even when thus masked they were freely visited by insects. The result shows that insects are in reality guided to flowers in the great majority of cases by their sense of smell,

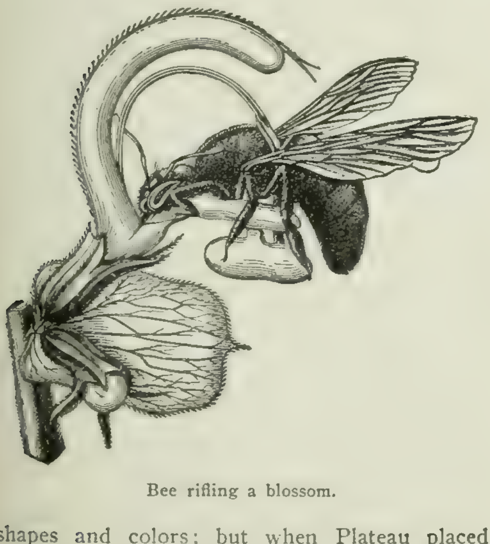
A hawk-moth sucking nectar from a tiger-lily.

the scent of the nectar attracting them. Some insects, as the white cabbage butterfly, are attracted by the white color of the flowers they visit, and yellow butterflies by yellow flowers. Undoubtedly some butterflies and moths have the color-sense, but probably those insects such as beetles, bugs, etc., which are most concerned in fertilizing flowers, are attracted by the odors emanating from the nectary and glands of such flowers.

Of flower-haunting flies (*Diptera*) the color-sense is shown in the case of certain higher types of flies which prefer red and blue flowers, and they oftener visit the more complicated kinds of flowers than do the smaller bees. These flies seem to possess greater importance for the function of pollination than previously supposed. In Africa some kinds of orchids are fertilized by flies.

It thus appears that though the colors of some flowers attract certain insects which have the sense of color, the most efficient insect-aids to fertilization of flowers are those which are attracted mainly if not solely by smelling the nectary or odor of the flower.

Plateau indeed claims that any flower is freely visited by insects if it be nectariferous, no matter how colorless or inconspicuous it may be. There are, on the other hand, flowers which seem to be wholly avoided by insects, many of which are gay and attractive enough in their



Bee rifling a blossom.

shapes and colors; but when Plateau placed nectar at the base of these flowers, visits of insects were at once begun. Meehan states that in the United States a single plant of the common sumac (*Rhus glabra*) was growing in an isolated spot almost hidden by other vegetation, and far away from any flowers visited to any great extent by insects. The flowers of this shrub are small, green, entirely inconspicuous, and so far as human olfactories go, odorless. But he observed an extraordinary number of kinds of insects visiting the flowers. He infers that this remarkable collection of insects, including honey-bees and wasps, could only have been guided by the sense of smell, and he infers that all plants with nectar have odor, though it may not be strong enough to be perceptible to man.

The nectary is a specially modified scent-gland, and the nectar is a specialized form of the sap or juice of the plant. As stated by Henslow, the nectaries probably originated from the visits of insects, and the local irritation set up by these visits gradually led to the origination of the glandular secreting organ called the nectary. When the entire flower degenerates and becomes self-fertilizing, not needing the help of insects, the nectary also disappears. Ant-plants are so-called because they are due to the modifications occasioned by the visits of ants.

Fertilization of Flowers by Insects.— We have seen that insects are strongly attracted to flowers by smelling the sweets secreted by glands or nectaries. How important this nectar is to bees is proved by the fact that the honey they produce is nectar changed to honey in their digestive organs. Many insects subsist on the pollen of plants; such are bees of all kinds which use it in making bee-bread as food for their young; multitudes of wasps, flies, and beetles gather also the pollen of flowers, and eat it, this being their only food, or they store it up as nourishment for their young.

Their visits to flowers result in their carrying the pollen from one flower to another, and thus fertilizing the plant. Hence owing to the visits of honey-making bees, of wasps, of moths, and butterflies, and of pollen-eating flies and beetles, the flowers become indirectly fertilized, and were it not for their visits, such flowers would be sterile, and the species die out.

As early as 1793 Sprengel discovered the main facts and many details as to the relations between flowers and insects. As Wallace states, he noticed the curious adaptation of the structure of many flowers to the particular insects visiting them; he proved that insects cross-fertilize flowers, and that the presence of nectar and pollen ensured the continuance of their visits. Afterward it was shown that cross-fertilization of plants was a benefit to them, while Darwin (saying that "nature abhors perpetual self-fertilization") proved that this was a general occurrence not only among ordinary plants but with orchids. It thus appears that insects have been the cause of, and are the means of maintaining, the present wealth of flowers which enliven the tropical forests, and adorn our northern gardens and fields.

Colors of Flowers and the Visits of Insects.— Although it is generally claimed that sweet odors are, as Wallace says, usually supplementary to the attractions of color, yet this view, as we have seen, will have to be modified. Gaudily colored flowers, like the sunflower, poppies, and peonies, are nearly scentless compared with plants like the mignonette, which are so fragrant. White flowers are fertilized by moths, and very frequently give out their scent only at night, as in the case of the butterfly-orchis. Bright red flowers are very attractive to butterflies, and are sometimes specially adapted to be fertilized by them, as many kinds of pinks, the corn-cockle, etc. Blue flowers are especially attractive to bees and other hymenoptera, as many as 67 species having been observed to visit the common European sheep's bit. Dull yellow or brownish flowers, some of which smell like carrion, attract flies, while the dull purplish flowers of the Scrophularia attract many wasps. (Wallace.)

It is interesting to learn that many change

their colors as soon as fertilized; in this way bees avoid wasting their time in visiting such flowers as have already been fertilized and their nectary exhausted. The common lung-wort is at first red, but afterward turns blue. In southern Brazil grows a species of Lantana whose flowers are yellow the first day, orange the second, and purple the third, while F. Müller observed that many butterflies visited the yellow flowers only, some both the yellow and the orange flowers, but none the purple. Moreover many flowers have been specially adapted to the kinds of insects that most abound where they grow. Thus in the Swiss lowlands the gentians, although with us they flourish in the White Mountain region, are adapted to bees, but those of the high Alps to butterflies only, as this zone is the home of Alpine butterflies. The visits of insects to flowers in fine weather are incessant and hence economy of time is, as Wallace states, very important both to the insects and the flowers, because the fine working days are comparatively few. For example, bees keep to one flower at a time, visiting hundreds of blossoms in succession; they thus acquire quickness in going at once to the nectary, and the change of color in the flower, or incipient withering when fertilized, enables them to avoid those flowers that have already had their honey exhausted.

Perforation of Flowers by Bees.— If one will watch a wistaria when in blossom, he will notice that the bumblebees, in order to get at the nectar without loss of time, perforate the corolla right over the nectary, and thus speedily rifle the flower of its sweets. So well trained is the bee that the hole is always made right opposite or over the nectary. On the other hand the honey-bee, with its shorter and weaker maxilla, cannot make a hole through the walls of the corolla, but partly enters the flower on one side or the other and with more or less trouble laps up the nectar. At the end of the season, provided bumblebees are plenty, nearly every flower on a large vine will be found to have been perforated. Similar flowers, as the clover, touch-me-not, etc., are thus perforated. Lovell states that the maxillæ alone are employed in this act, being moved slowly backward and forward in puncturing the tissue. Thus the stout strong maxillæ of the bumblebee are adapted for this purpose.


Click-beetle and orchid.

Irregular Flowers due to Visits of Insects.— It is now thought by some observers that owing to the strains, pressure, and irritation caused by the visits of insects, flowers like those of the pea, bean, etc., have been formed. Henslow points out that the lower petal or lip of these irregular flowers forms a platform on which the bee rests while engaged in probing the corolla for nectar. In the irregular flowers of the foxglove, petunia, etc., the tube of the corolla has enlarged so as to allow the ingress of an insect which partly crawls into it, hence the tubular corolla having to bear the strain upon it bulges outward, while the lip or anterior petal is not much if at all enlarged. Even if, says Henslow, no more than the head of an insect enter the flower, then the corolla shapes itself to fit it. He explains the formation of the deep tubular corolla of the evening primrose or the honeysuckle by the fact that butterflies, in probing their depths while on the wing, irritate the tube only, which is thus made to become longer and correspondingly to contract in diameter, the result being that there is but little irregularity in the shape of the flower. The immediate mechanical cause of the shape of the wing-petals of many pea-blossom-like flowers is probably due to the weight of the insect in front, the local irritations believed due to the thrust of the insect's head and its probing for nectar, united with the absence of all strains upon the sides. An example of the great thickening of the tissue just where the strain will be most felt is the flower of the lady's slipper and Calceolaria.

Origin or Modification of Insects by Flowers. — We have seen that flowers attract insects by means of their nectar and sweets and also their pollen; that the visits of insects are in favorable days practically incessant, though owing to the weather more or less intermittent; the result seems to be that the forms of insects, especially of their accessory jaws (maxillæ and labium), as well as of their legs, are wonderfully adapted to their habits. It is not improbable that by these simple mechanical causes, that is, the use or exercise of the parts concerned in gathering pollen and nectar, a number of groups of insects (bees, certain flies, and the moths and butterflies, and certain families of beetles) have been brought into existence. We know that in all probability flowers and the insects which visit them, came into existence after the coal period, owing to the reaction of flowers upon these kinds of insects, causing the exercise and modification of the structures actively employed in collecting pollen. Among the flower-visiting flies and beetles the proboscis of the former, and the maxillæ of the latter, are wonderfully adapted for scraping off the pollen from the anthers of flowers.

Consult: Darwin, 'Forms of Flowers' (London 1877); Müller, 'The Fertilization of Flowers' (London 1883); Henslow, 'The Origin of Floral Structures Through Insect and other Agencies' (New York 1893).

ALPHEUS S. PACKARD,
Late Professor of Zoology, Brown University.

Flowers, Artificial, flowers made from various materials to imitate natural blossoms. These are not a modern invention. The famous floral wreaths made by the ancient Egyptians were formed from thin plates of horn stained in different colors, sometimes also of leaves of copper, gilt or silvered over. The Romans excelled in the art of imitating flowers in wax and in this branch of the art attained a degree of perfection which has not been approached in modern times. Crassus, renowned for his wealth, gave to the victors in the games he celebrated at Rome crowns of artificial leaves made of gold and silver. In modern times the Italians were the first to acquire celebrity for the skill and taste they displayed in this manufacture, but they are now far surpassed by English and French manufactures, more especially by the latter.

The first artificial flowers made in modern times in civilized countries were manufactured out of many-colored ribbons which were twisted together and attached to small pieces of wire. But these first attempts were decidedly crude. In course of time feathers were substituted for ribbons, a more delicate material, but one to which it was not so easy to give the requisite shades of color. The plumage of the birds of South America is admirably adapted for artificial flowers on account of the brilliancy and permanence of the tints, and the natives of that continent have long practised with success the making of feather flowers. The Zoological Gardens in Regent's Park, London, contain a magnificent collection of artificial flowers made out of the feathers of humming-birds. In South America artificial flowers are also composed of the wing cases and other parts of some brilliant specimens of beetles. In Italy the cocoons of silkworms are frequently used for the purpose, as these take on a brilliant color and have a velvety appearance. Among the other materials used in this manufacture are cambric, muslin, satin, velvet, and other woven fabrics, blown glass, mother of pearl, brass, thin layers of whalebone, etc., beside the various vegetable and mineral coloring matters. Flowers were at one time made of porcelain and were perfumed. Great skill has been attained in the making of glass flowers and a remarkable collection of this kind is owned by Harvard University.

Flowers, Symbolism of, a special significance attached to flowers by means of which they are made to represent various ideas and sentiments. This mode of communicating thought has developed in certain countries into a language of remarkable elaboration. Among the Greeks and Romans the use of flowers was full of significance. Though the well-developed floral speech of the Romans was probably lost to a great extent, the study was revived in Europe during the Middle Ages, being especially appropriate in connection with such a romantic institution as chivalry. The Orientals have developed the language of flowers into a vehicle for communicating sentimental and amatory expressions of all degrees of warmth. Still further complexity is added by the habit of employing flowers the Turkish or Arabic names of which rhyme with the other really significant words. The language of flowers is, of course, arbitrary, and a bouquet which a Persian girl would understand would be unintelligible to an Egyptian inmate of the harem. Yet among European nations certain flowers have a common significance. The rose is widely accepted as the symbol of love and beauty; the forget-me-not of true love; the lily of purity; the violet of modesty; the daisy and white violet of innocence; the rosemary of remembrance; the amaranth of immortality; the asphodel of death and the unseen world; the pansy of thought; the hyacinth of sorrow; the narcissus of self-admiration; the poppy of oblivion. The almond expresses hope; the lily-of-the-valley unconscious sweetness; the wallflower, love faithful in spite of adversity; the primrose, early youth; and the cyclamen, diffidence. So surely as the orange-blossom is associated with marriage does the finding of white heather betoken good-fortune to come, while the future chances of love may be revealed from the daisy and poppy by a simple method of divination. The laurel has long been accepted as the emblem of glory, and the oak of patriotism. In the Grecian games wreaths were placed upon the brows of the victors, but these were of leaves rather than blossoms. Floral garlands were much used at the feasts of the ancients, and in India it is customary to show special honor to a guest by encircling his neck with a wreath of flowers. Historical and national associations cluster about certain flowers. The violet was the flower of Athens. The red and the white roses of Lancaster and York gave name to a great civil war. Particular families and clans have their floral badges and there are national and heraldic emblems drawn from the floral kingdom, such as the rose of England, the thistle of Scotland, the shamrock of Ireland, and the fleur-de-lis (q.v.) of France, the latter being associated for centuries with the royal crown. The pomegranate became a Spanish national emblem having previously been the emblem of Moorish Granada. In Japan, the chrysanthemum is the flower of the nation, and in India the lotus has an especially sacred significance, as it had formerly in Egypt. In the latter country it often figured in architecture. In the decorative art of India it is represented in bronze and in paintings in connection with divinities or exalted sages. The cactus is the national emblem of Mexico. No flower will ever become the national emblem of the United States in the manner in which such floral emblems have become connected with other nations, but an attempt has been made to gain an expression of popular opinion on the subject of a national flower and the golden-rod appears to lead in the contest, as it has done in the case of the Empire State, of which it has been chosen as an emblem. The legislatures of certain States have taken action on the choice of a State flower, Utah selecting the seg lily; Vermont, the red clover; Oregon, a native grape; Nebraska, the golden-rod; Michigan, the apple-blossom; Maine, the pine tassel and cone, and Iowa the wild rose. In England what may be called a party emblem is illustrated in the adoption of the primrose, generally known as Lord Beaconsfield's flower, by the Conservatives. Before the «Hundred Days» in French history, the violet was used by the adherents of Napoleon I. to symbolize the hope of his return from exile.

Floyd, John Buchanan, American statesman: b. Smithfield, Montgomery County, Va., 1 June 1807; d. near Abingdon, Va., 26 Aug. 1863. He was educated at Columbia College, S. C., graduating in 1829. Studied law and settled in southwest Virginia. Was a member of the Virginia legislature several terms, and was governor of the State 1850–3, his term being notable for his advocacy of the policy of public im- of war in the cabinet of President Buchanan, provements. In 1857 he was appointed secretary and remained in it until 29 Dec. 1860, when he resigned because he considered the action of Maj. Anderson in occupying Fort Sumter a breach of faith to South Carolina. He went to Abingdon, Va. On 29 Jan. 1861 the grand jury of the District of Columbia indicted him as privy to a defalcation in the Department of the Interior. He returned to Washington, gave bail and demanded a trial, and the government thereupon, on 7 March 1861, entered a *nolle prosequi.*

After his departure he was also accused of having transferred arms from Northern to

Southern arsenals in order to arm the South for the Civil War. This charge was investigated by a Congressional committee, which, on 18 Feb. 1861, made a report showing it to be groundless, the arms transferred having been condemned arms, removed in order to make room in the Northern arsenals for modern ones.

In the summer of 1861 he was appointed a brigadier-general in the Confederate army, and raised a brigade which served in West Virginia until ordered to join the army of Gen. A. S. Johnston in the West. He was sent to Fort Donelson, arriving there after fighting had begun. When surrender was discussed, he transferred the command to Buckner and extricated his brigade; in consequence of which he was removed from command by Jefferson Davis. The State of Virginia thereupon appointed him a major-general in its service.

Floyd, William, American statesman: b. Brookhaven, Long Island, N. Y., 17 Dec. 1734; d. Weston, Oneida County, N. Y., 4 Aug. 1821. He entered political life as a delegate to the Philadelphia congress of 1774. The next year he was appointed a delegate to the first Continental Congress, and continued by successive reappointments a member of every Continental Congress up to 1782 inclusive. From 1777 to 1788 he also was a State senator under the first Constitution of New York, and in the Presidential elections of 1792, 1800, and 1804 was a Presidential elector.

Flück'iger, Friedrich August, ow'goost frēd'riH, German pharmacognosticist: b. Langenthal, Switzerland, 1828; d. 1894. He was educated at Berlin, Ban, Geneva, and Heidelberg, became president of the Swiss Association of Apothecaries in 1857, and in 1881 was member of a committee appointed to revise the pharmacopœia of the German empire. He wrote, in conjunction with Hamburg, 'Pharmacography: A History of the Principal Drugs of Vegetable Origin met with in Great Britain and British India' (1879), and works in German and French on the nature and history of drugs.

Flue. (1) A passage for the conveyance of the volatile results of combustion from the fireplace to the open air, or into another passage; a smoke duct, a chimney; one of a cluster of smoke ducts in a stack of chimneys. Also a passage in a wall for the conveyance of heat from one part of a building to another. (2) In music, one of the divisions of organ-stops, so called because the sound is produced by the wind passing through a fissure, flue, or windway, and striking against an edge above. (3) In a steam-engine, a pipe for the conveyance of the caloric current through a boiler, to heat the surrounding water. It is usually secured in the sheets of the fire box and smoke box respectively, as in the locomotive.

Fluel'len, a humorous character in Shakespeare's play 'Henry the Fifth.' He is a disputatious little soldier, pugnacious, and as voluble as his Welsh accent permits him to be when attempting to speak English.

Flü'gel, Johann Gottfried, yō'hän gōt'frēd, German lexicographer: b. Barby on the Elbe 22 Nov. 1788; d. Leipsic 24 June 1855. He spent many years in the United States prior to 1820 in business, diplomatic and official occupations, and became professor of English in the University of Leipsic in 1824. He compiled a 'Complete English-German and German-English Dictionary' (1830), besides publishing 'A Series of Commercial Letters' (9th ed. 1874); 'Practical Handbook of English Business Correspondence' (9th ed. 1873); 'Triglot; or Mercantile Dictionary in Three Tongues — German, English, French' (2d ed. 1854); and other useful manuals, all revised, or brought down to contemporary needs, by his son.

Flügel, Otto, German philosopher: b. Lützen 1842. He studied at Schulpforta and Halle, and took up pastoral work; was made editor of the 'Zeitschrift für exacte Philosophie im Sinne des Neueren Philosophischen Realismus,' and in 1894 was one of the founders of 'Zeitschrift für Philosophie und Pädagogik.' He supports Herbartian realism, as opposed to New-Kantian speculations, yet he believes in the necessity of a revelation. Among his works may be mentioned: 'Die Spekulative Theologie der Gegenwart'; 'Das Ich und die sittliche Idee im Leben der Völker' (1892); 'Über die persönliche Unsterblichkeit' (1902).

Flüg'gen, Gis'bert, German painter: b. at Cologne 9 Feb. 1811; d. Munich 3 Sept. 1859. In his youth he learned the manufacture of novelties in his native town, and in 1833 began his art studies at Munich, which he made his permanent home. He is a German counterpart of Hogarth and Wilkie, whom he rivals in masterly grouping and life-like expression, while in the technique of the brush he excels them both.

Fluid, a substance devoid of rigidity, or whose modulus of rigidity (see ELASTICITY) is zero. The word includes both gases and liquids, since these bodies, while resisting compression, offer no sensible resistance to change of form, but yield continuously and without limit to any force which tends to alter their shape while leaving their volume constant. The word "fluid" is also figuratively applied to other things which may be conveniently represented to the mind as fluids, even though it is known that they are not such. We speak, for example, of the "electric fluid," thereby meaning electricity, whose motions and general properties are known to conform to certain differential equations that are strongly suggestive of those governing the motions and properties of true fluids. This figurative use of the word is now avoided by the best writers, because, while it is convenient from certain points of view, it connotes properties that the things that it stands for do not possess. It dates from the time when electricity, magnetism, nervous energy, and certain other obscure manifestations of nature were actually believed to be due to imponderable fluids that were supposed to have a real, objective existence. See CRITICAL POINT; ELASTICITY; GAS; GASES, KINETIC THEORY OF; LIQUID; MATTER; THERMODYNAMICS; etc.

Fluid Lens, in optics, a lens in which a liquid is imprisoned between circular glass disks of the required curvatures. Attempts to obtain achromatism have been made by using metallic solutions and other liquids having a higher dispersive power than flint glass.

Fluke, or Pole Flounder, a fish, one of the smaller deep-water flounders (*Glyptocephalus cynoglossus*), common near both coasts of the North Atlantic, caught by means of beam-trawls in great quantities, and highly prized as food, especially in Great Britain, where it is considered little inferior to the sole. It is the "craig fluke" of Scotland. See FLOUNDER.

Fluke-worm. See DISTOMA; TREMATODEA.

Flume (Latin *flumen*, stream), an artificial channel or conduit used to convey water for power development, hydraulic mining and irrigation. Flumes are commonly built of wood, but may be of steel and are placed above ground, frequently over trestles. See IRRIGATION; LOGGING; MINING.

Flu'or-spar. See FLUORITE.

Fluores'cence, that property of certain bodies in virtue of which they become self-luminous when exposed to light of certain wave-lengths. All bodies reflect a part of the incident light, but fluorescence is more than a mere reflection, as may best be shown by an example. "Canary glass" (glass colored slightly with oxid of uranium) exhibits a beautiful yellowish-green surface color when well illuminated, and for this reason it is much used for the production of ornamental effects. If a ray of sunlight be admitted into a darkened room through a piece of cobalt glass that is so dense that the feeble violet light that it transmits is barely visible, the canary glass shows its yellow-green color brilliantly when placed in its path. This shows that the phenomenon is not simple reflection, and further evidence of the same sort may easily be had. Glass that is tinged brownish-yellow by oxid of gold is almost perfectly transparent to the golden light from the canary glass, but if the violet light from the cobalt glass is caused to traverse the gold-oxid glass before striking the canary glass, the fluorescence is no longer observed. Furthermore, light that has passed through one piece of canary glass is incapable of exciting fluorescence in a second piece. These and other equally remarkable phenomena indicate that a fluorescent substance absorbs a portion of the light that strikes it, modifies it profoundly in some manner, and then radiates it again. Stokes has shown that the modification consists in increasing the wave-length of the incident light; and it is now known that fluorescent light invariably has a greater wave-length than the primary light that excites the fluorescence. This fact has an important bearing upon many of the phenomena of physics. When it had been determined, for example, that the "X-rays" differ from ordinary light merely by having a very different wave-length, the question whether their wave-length is longer or shorter was immediately answered by the fact they can excite brilliant fluorescence. Knowing that the X-rays are either too long or too short to affect the eye, and knowing also that fluorescent light always has a longer wave-length than the light that excites it, it follows at once that the X-rays have a shorter wave-length than ordinary light.

Many substances exhibit fluorescence to a greater or lesser degree. An aqueous infusion of horse-chestnut bark shows it brilliantly, and so also does a solution of sulphate of quinine. Certain of the coal-tar colors (q.v.) are conspicuously fluorescent, fluorescein taking its name from this fact. Kerosene is fluorescent, and sometimes strongly so. Most fluorescent substances cease to emit light almost instantaneously when the incident light is cut off from them. Some, however, such as calcium tungstate and the sulphids of calcium, barium, and strontium, continue to emit their rays for a sensible time, fading gradually away into darkness after the incident light ceases to excite them. Instruments consisting of screens that are coated with some fluorescent material and protected from ordinary light by shields, or by enclosure within a light-tight box, are known as "fluoroscopes," and are used for studying the X-rays (or Röntgen rays), and the shadows cast by them. It is to be observed that fluorescence differs from phosphorescence (q.v.) not only because it is usually of very short duration, but primarily because it is induced by the exciting action of light-rays. Phosphorescence may be due to very different causes. The light emitted by phosphorus, for example, is probably due to the slow oxidation of that substance. That which is observed in the ocean at night, and in connection with various fungi and insects, is due to causes which are more or less obscure; but in any event these various phosphorescent phenomena are quite different from true fluorescence. The name "fluorescence" was coined by Sir George G. Stokes in 1852, from the fact that the mineral fluorite sometimes exhibits the phenomenon. Previous to 1852 fluorescence was known as "epipolic dispersion." Consult: Tait, 'Light'; Preston, 'The Theory of Light.'

Flu'orides. See FLUORINE.

Flu'orine, a gaseous, non-metallic element, possessing properties resembling those of chlorine, and exhibiting powerful chemical affinity. It occurs abundantly in nature, notably in the minerals fluorite and cryolite, from the former of which it takes its name. The elementary character of fluorine was first recognized by Ampère and Davy about 1810; but although many attempts were made to isolate it, none was certainly successful until 1887, when Moissan succeeded in preparing it in the elementary state by electrolyzing a solution of hydrogen potassium fluoride, HF.KF, in perfectly anhydrous hydrofluoric acid, the solution being contained in a platinum vessel whose temperature was maintained at 10° F. below zero, and the electrolysis conducted by means of 20 Bunsen elements connected in series. When thus prepared fluorine is a gas, variously described as colorless, or as of a light greenish-yellow color. Many of the elements take fire when immersed in it, and burn with the formation of the corresponding fluorides. Water is decomposed by it, with the formation of hydrofluoric acid, HF, and the liberation of ozonized oxygen; and in fact fluorine appears to combine with all known elements except oxygen and carbon, and argon, helium, and the other recently discovered inert gases of the atmosphere. Fluorine has the chemical symbol F, is a monad, and has an atomic weight of about 19. Few of the physical properties of the element are yet known, on account of the difficulty of handling it. It corrodes glass rapidly, for example, and for this reason glass vessels cannot be used in experimenting with it.

Fluorine combines with hydrogen directly even in the dark, the compound, HF, that is

formed being known as hydrofluoric acid. Hydrofluoric acid is more conveniently prepared by means of the action of strong sulphuric acid upon the mineral fluorite (calcium fluoride, CaF_2). The reaction is as follows: $H_2SO_4 + CaF_2 = 2HF + CaSO_4$. Hydrofluoric acid is a colorless gas at ordinary temperatures and pressures, fuming strongly in the air. It condenses at 5° F. below zero to a colorless, mobile liquid having a specific gravity of about 0.988, and boiling, at ordinary atmospheric pressure, at 67° F. As thus prepared, liquid hydrofluoric acid contains traces of water; but these may be removed by electrolysis, the liberated fluorine combining with the water as noted above, and the oxygen of the water escaping in the free state. When the water has all been eliminated, electrolysis ceases. The commercial importance of hydrofluoric acid depends upon the fact that this substance attacks glass so freely that it must be prepared and stored in vessels of lead or rubber. It is much used for etching upon glass, the reaction between the glass and the acid being $4HF + SiO_2 = 2H_2O + SiF_4$; the acid attacking the silica of the glass, with the formation of water and a gaseous compound of silicon, known as silicon tetrafluoride. When silicon tetrafluoride is passed into water, it is decomposed according to the equation $3SiF_4 + 4H_2O = 2H_2SiF_6 + H_4SiO_4$; the substance represented by the last term in this equation, silicic acid, separates out as an insoluble precipitate, while the compound H_2SiF_6, known as hydrofluo-silicic acid, remains in solution. Hydrofluo-silicic acid forms salts which are known as silico-fluorides. Potassium silico-fluoride, K_2SiF_6, is one of the few potassium compounds that are insoluble in water.

Liquid anhydrous hydrofluoric acid does not attack glass, but the action is vigorous when traces of water are present. The diluted acid is therefore used in practical etching, the article that is to be treated being immersed in it, after the parts that are not to be attacked have been protected by a coating of wax, or of a special "etching varnish." Hydrofluoric acid in aqueous solution acts very similarly to hydrochloric acid, forming salts which are known as fluorides; hydrogen being liberated when the acid acts upon a metal, and water when upon an oxid.

Fluorite, or **Fluor Spar,** a native fluoride of calcium having the formula CaF_2, crystallizing in the isometric system with cubical habit, and also occurring massive. It has a hardness of 4. and a specific gravity varying from 3.00 to 3.25. It has a vitreous lustre, and is transparent to subtranslucent, varying in color from white through yellow, green, red, blue, and brown. The green and violet-blue varieties are most common, and the red is rare. Certain specimens exhibit a bluish fluorescence (q.v.), and the mineral develops differences of electrical potential under the influence of heat and of light. Fluorite occurs in England, Germany, and many parts of the United States, and the commercial supply comes chiefly from Kentucky, Illinois, Arizona, Tennessee, and New Hampshire. It is a chief source of fluorine and hydrofluoric acid (see FLUORINE), and is also used as a flux for promoting the fusion of certain refractory minerals, deriving its name from this latter circumstance (Latin, *fluor*, a flow). Colorless specimens have been used for the manufacture of lenses, for which they are well adapted on account of their small dispersion.

Fluor'oscope. See FLUORESCENCE.

Flürsheim, Michael, mēн'ä-el flürs'hīm, German social reformer: b. Frankfort-on-Main 24 Jan. 1844. He emigrated to the United States in 1867, and resided there for five years. He then returned to Europe and established an iron foundry in Gaggenau, Baden (1888). Since 1892 he has lived at Castagnola, near Lugano, Switzerland, engaged in disseminating his ideas through his writings. He believes private property is the cause of immense wealth to some and profound poverty to others, and advocates the government possession of land. His works are: 'Auf friedlichem Wege' (1884); 'Deutschland in 100 Jahren' (1894); 'Papst und Sozialreform' (1891); 'Der Einzige Rettungsweg' (1894); 'Rent, Interest, and Wages' (1891).

Flush'ing, Netherlands, a flourishing seaport town in the province of Zeeland, on the south coast of the island of Walcheren, at the mouth of the West Schelde. It has long been a place of importance, but has few buildings or institutions of note. The town-house is a roomy, suitable edifice; the exchange is a simple building, and near it is a statue, erected in 1841, of Admiral van Ruyter, born in Flushing in 1607. The inhabitants are chiefly engaged in commerce, for the encouragement of which much has been done in recent times by the construction of docks, etc. Flushing has suffered several times from fire, water, and war, and in 1809 was bombarded by a British fleet, under Lord Chatham. Pop. (1901) 18,893.

Flushing, N. Y., a former village on Long Island, now a part of the borough of Queens, New York. It was settled in 1645 and was called Vlissingen.

Flute, a musical wind instrument, consisting of a tube furnished with a number of holes in it for the purpose of varying its sounds. The oldest form of the English flute had seven holes which could be stopped by the fingers, but it had no finger-keys. This was in use till about the beginning of the 18th century, when it gave place to the German flute, an instrument which, in its best form, was 27 inches in length, consisted of 4 pieces fitting into one another, and had 6 finger-holes for the normal tones, and from 6 to 12 keys for the semitones, with a compass of nearly 3 octaves, counting from middle C upward, the higher octaves being obtained by overblowing. The improvements made on this instrument, by Böhm, a German, acting in conjunction with Gordon, an Englishman, enable the player to perform music on any key, with all the chromatic intervals. The chief improvement consisted in the application of a system of keys, by which several holes could be stopped at one time, by one movement of the finger. The flutes made by Böhm are now taken as the models by most makers in all countries. In modern flutes the number of keys varies. The materials of which flutes are made are box, ivory, ebony, silver, glass, and a kind of red ebony.

Fluted Scale. See SCALE INSECTS.

Fluting, in architecture, channels or furrows cut perpendicularly in the shafts of columns, particularly Doric, Ionic, and Corinthian.

It seems probable that this kind of ornament had some relation to the original type; perhaps the furrowed trunk might have suggested the idea. It is, however, a beautiful ornament, which is applied with equal happiness to break the otherwise heavy mass of a Doric shaft, or to obviate an inconsistent plainness in the other orders. When the lower parts of the flutes of a column are filled with a convex bead, they are said to be cabled. See ARCHITECTURE.

Fluting Machine, a machine for corrugating or crimping metals. It has a pair of rollers, each one having projections which enter the interdental spaces of the other. By turning the operating screw the bent bar, and with it the upper roller, can be adjusted up or down at will to regulate the distance between the two rollers.

Flux, a substance or mixture added to assist the fusion of minerals. In the large way, limestone, and fluor-spar are used as fluxes. In the smelting of iron great attention has to be paid to the fluxes, because on their character depends to some extent the complete separation of the metal. To accomplish this the flux must be such that it will combine with the earthy matter of the ore, and form a slag, which must neither be too refractory nor fusible. Hence if the ore abound in clay or sulphur, lime, or limestone, and possibly sand, must be added; if in quartz, lime and clay are requisite, otherwise the quartz is slagged by combining with part of the iron, which is thus lost. Frequently ores are so selected that the earthy matters present may flux each other, but this requires skill and experience. The fluxes used in pottery are very various, and are distinguished by different names; but they almost all consist of litharge or red-lead, with sand or boracic acid, sometimes singly, sometimes together. They are, therefore, essentially colorless glasses used as vehicles for infusible colors. See COPPER; IRON; etc.

Fluxion, fluk'shôn, (1) in medicine, an unnatural flow or determination of blood or other humor toward any organ; a catarrh. (2) In mathematics, a method of calculation resulting from the operation of fluents, or flowing numbers. Thus a mathematical line may be considered as produced by the fluxion or flowing of a point; a surface by the fluxion of a line, and a solid by the fluxion of a surface. A mathematical point in motion will really make a line; a revolving radius which is a line will make a circle which is a surface, and its revolution about its diameter will generate a sphere which is a solid. The same principle may be applied to purely numerical calculations, like the formulæ of algebra. This branch of the higher mathematics was invented by Newton in 1665. In 1676 he communicated his method to Oldenburg in a sentence with all the letters disarranged so that his correspondent could not possibly have put them in order. If he had succeeded in doing this the sentence would have been *Data æquatione quotcunque fluentes quantitates involvente fluxiones invenire et vice versa.* ["Given it makes no matter how many equations involving fluent quantities, fluxions are to be discovered, and the reverse is true" (that is, where fluxions occur the fluents are to be found).] Leibnitz received this letter in 1677, and in 1684 explained a discovery which he had made. It was that of the differential calculus, which was essentially the same as that of fluxions. What Newton called fluxions, Leibnitz called differences. An angry controversy subsequently arose between Newton and Leibnitz as to the priority of discovery, the Royal Society of London taking the part of the former, who was then its president, and the scientific men of Germany that of the latter, who was their countryman. Both appear to have made the discovery independently. In the slight differences of method which exist, the advantage lay with Leibnitz, and while the term fluxions is now scarcely ever used, that of differential calculus is in common use. The first elementary treatise on fluxions published in England was by John Harris in 1702. A description of the process by Newton himself followed in 1704, in his 'Quadrature of Curves.' See CALCULATION; MATHEMATICS.

Fly, an insect. See DIPTERA; FLIES; and the names of various groups and species of flies.

Fly-blister, a collection of blood-serum between the layers of the skin, caused by the application of some preparation of the Spanish fly. It is used to extract fluid from underlying tissues, and to cause desired changes in local circulation. Absorption from applications sometimes takes place, giving rise to the irritation and inflammation of the kidneys, bladder and genital organs which characterize the drug when taken internally.

Fly-casting, the art of throwing an artificial fly in angling. (For the various methods employed see ANGLING.) Aside from its use in actual fishing the art is employed by some in competitive contests, and "national tournaments" are held annually in both Great Britain and the United States, sustained by a federation of clubs devoted to the sport, in which the championship and prizes are competed for.

Fly River, a considerable stream in New Guinea (British) which has its source in the Victor Emanuel Mountains and empties into the Gulf of Papua. Its length is 150 miles. There is a delta at the mouth of Fly River in which lies the island of Kiwai.

Fly Sheet, a paper broadside or bill. Certain publications of this sort advocating changes in the English Wesleyan Methodist constitution and practice were published in 1847–8. Those who were suspected of having them issued were expelled in 1849, and taking the name of Methodist Reformers laid the foundation of a new denomination, which has, however, since been amalgamated with others, the designation of the collective body being the United Free Church Methodists.

Fly, Spanish. See BLISTER BEETLE.

Fly-up-the-Creek, a local name for the little green heron (*Ardea virescens*), a common bird throughout eastern North America. See HERON.

Flycatcher, popularly and broadly used, birds which catch insects in the air. More restrictedly, in ornithology, birds of the Old World insectivorous family *Muscicapidæ*, allied to the thrushes; but this is a group very difficult to limit or define. All these are small, active

birds, with great activity in flight and skill in seizing their agile prey; and all have broad flattened beaks, at the base of which is a growth of long stiff rictal bristles. The feet are usually weak and the wings long and pointed. Four or five species are common summer visitors to Europe, including the familiar and typical spotted flycatcher (*Muscicapa grisola*) and the pied or blackcap (*M. atricapilla*). In all the hotter latitudes of the Old World the species are very numerous, and ornate, many being crested, or having, in the case of the males at least, very long tail-feathers, which are handled most gracefully. Such are the paradise flycatchers (genus *Tersiphone*) of India and eastward, the Japanese species of which is so commonly represented on painted or embroidered screens. The "fantail" (q.v.) is another species remarkable in its flight. Most of these flycatchers are birds of the woods, and are usually solitary and silent, feeding on little except insects, which are habitually caught upon the wing with an audible snap of the bill. Some of the smaller ones are sometimes called "fly-snappers" (q.v.). They nest in various situations, and many make highly beautiful receptacles for their variously decorated eggs.

None of the muscicapids is to be found in the New World, but America has a large family of flycatchers (the *Tyrannidæ*) just as suitably so-called as are the others, so far as habits are concerned; nor are they far removed in structure. This family contains some 400 species, mainly tropical, and chiefly of an olive-green, or black-and-gray complexion, often with ornamental touches of scarlet on the head or wings. The bill is rather stronger as a rule than in the Old World flycatchers, and often decidedly hooked, like that of vireos or shrikes. The wings are usually short, and the tail varies greatly, sometimes being beautifully prolonged, as in the scissor-tailed flycatcher of the western United States. The genus *Alectrurus* presents still more striking examples of very long and beautifully modified tail plumes. Good examples of this group are the king-birds, pipiris, pewees, vermilion flycatcher, and scissor-tail, elsewhere described. An excellent general account of these families will be found in Evans' 'Birds' (1900).

Ernest Ingersoll.

Flying Bridge. See Bridge; Movable Bridges.

Flying Buttress, a contrivance by means of which the thrust of a vault or arch is carried across an open space to a buttress (q.v.). Nearly every instance of the use of the flying buttress is in connection with Gothic architecture, and some of the earliest forms are very curious and illustrate well the growth of the style. The "high vault" over the nave or choir should have a buttress on each side to resist its thrust, but to build one there would be to obstruct the aisle on either side, which it was important to leave open and free as a part of the great interior of the church. The buttress, therefore, was built outside of the aisle, where it took up the thrust of the aisle vault and was made much larger than necessary for that purpose so as to receive also the thrust of the high vault, which was transmitted to it by means of a sloping bar of stone carried on a separate arch or half-arch. This bar and half-arch taken together form the flying buttress. In large churches the flying buttress is sometimes double or two-fold, leaping over two aisles, or an aisle and a row of chapels; and again it is sometimes repeated in height, one flying buttress coming above another — these being sometimes an addition where a slight yielding was visible.

Flying Dragon, a flying lizard (q.v.) of the Oriental genus *Draco*.

Flying Dutchman, a phantom ship said to be seen in stormy weather off the Cape of Good Hope, and thought to forebode ill luck. One form of the legend has it that the ship is doomed never to enter a port on account of a murder committed on board; another, that the captain, a Dutchman, swore a profane oath that he would weather the Cape though he should beat there till the last day. He was taken at his word, and there he still beats, but never suceeds in rounding the point. He sometimes hails vessels and requests them to take letters home from him. The legend is supposed to have originated in the sight of some ship reflected from the clouds. It has been made the groundwork of one or two novels and of Wagner's opera 'Der Fliegende Holländer.'

Flying-fish, a fish able to leave the water when alarmed or pursued, and sustain itself for several seconds in the air. In tropical seas the flying-fish rise from the water in flocks, or, more properly, shoals, of many thousands at a time, when disturbed by the passing of a ship, or pursued by such foes as the bluefish and albicore. They spring from the crest of a wave, and, darting forward, plunge into another to wet the membrane of the fins, and in this manner continue their flights for several hundred yards, often pursued by marine birds in the element to which they are driven for protection against the tyrants of their own. The sole motive power is the propulsion obtained by the work of the tail in giving the rushing leap from the water; but the great pectorals act to some extent as parachutes. In all the species belonging to the genus *Exocœtus* (which is typical of the family *Exocœtidæ*, allied to the sauries), the pectoral fins are very much developed, and the superior lobe of the caudal fin shorter; the head and body are invested with large soft scales, and the body has a ridge or carina extending longitudinally along each flank, which gives it somewhat of an angular appearance. Head, when viewed from the front, triangular; eyes very large; air-bladder very large. Flying-fish are inhabitants of every temperate sea, though abounding in the vicinity of the equator. In length they rarely exceed 13 inches, and are commonly found about 8. The flesh is pleasant. Several species are described by naturalists, some of which have very long fleshy filaments depending from the lower jaw, the use of which is not known. The *Exocœtus volitans*, or common flying-fish of the Atlantic, is also known in Pacific waters; and the coast of California is visited by a large species, 18 inches long (*E. californicus*) called *volador* by the Spanish fishermen. About 65 species are contained in this and other genera, among which is *Fodiator*, with at least one common flying-fish (*F. acus*), distinguished by sharpness of its snout. Another sort of flying-fish is the gurnard or sea-robin (qq.v.).

FLYCATCHERS.

1. Spotted Flycatcher. 2. Pied Flycatcher. 3. White-collared and Red-breasted Flycatchers.
4. Kingbird. 5. Bienteveo

Flying-fox, or **Fox-bat,** one of the great fruit-bats (q.v.) of the Oriental region; specifically the kalong (*Pteropus edulis*), which is regarded as good food by the people of Java and neighboring islands. It is the largest of known bats, measuring five feet in expanse of wings, has rusty red fur, woolly upon the neck, and a long pointed fox-like muzzle, short, triangular ears, and large eyes. These bats belong to a very large widespread genus, and have the general characteristics and habits of the fruit-bats (q.v.).

Flying Frog, a Malayan tree-dwelling frog of the genus *Rhacophorus*, which has large webbed feet with adhesive disks. Some 20 species are known in various parts of the tropics, one of which was believed by Wallace to sail down from trees in a long slanting flight; but there is no direct evidence of it as to any species. A full account of the varied habits of the genus will be found in Gadow's 'Amphibia and Reptiles' (1901).

Flying Gecko. See FLYING-LIZARD.

Flying Gurnard, or **Robin.** See FLYING-FISH.

Flying-lemur. See COLUGO.

Flying Lizards. Various lizards are provided with something more or less elaborate in the way of a parachute assisting them in springing from branch to branch, and perhaps in frightening off would-be enemies. Thus a Malayan gecko (*Ptychozoon homalocephalon*), about eight inches long, with membranous expansions along the sides of the neck, body, tail and limbs, which are supposed to enable it to make long, sliding leaps; but its habits are very little known. The term applies especially, however, to the East Indian "flying-dragons" or showy lizards of the genus *Draco*, which have loose folds of skin distensible by the erection of several movable ribs, and spread as a parachute. There are various species, harmless, pretty and tamable.

Flying Machine, a device for enabling man to navigate the air. The feat of flying has been often attempted; even among the ancients it was tried, and we are informed, succeeded to some slight extent. Friar Bacon affirms in his writings that this feat is not only possible, but he also informs us that he himself knew how to construct a machine in which a man, in a sitting position, might be able to transport himself through the air like one of the feathered tribe. The secret of Friar Bacon consisted of a very simple mechanical contrivance: It was a pair of globes made of hollow copper, exhausted of air, on which a chair could be supported, by which means a man could float in the atmosphere above the earth, and could buoy himself along. Another friar asserts the truth of this invention, or, at least, of one similar. Father Francisco Lana declares that a round vessel of plate-brass, 14 feet in diameter, weighing 3 ounces per square foot, will only weigh 1,848 ounces; whereas a quantity of common air of the same bulk will weigh 2,155 2-3 ounces; consequently he deduces the fact that the globe will not only be sustained in the air, but that it will be capable of supporting a weight of 373 2-3 ounces; and also that a globe of the same weight, but greater in capacity, would support a man. This, however, is a fallacy; for, from the fact of nature abhorring a vacuum, the globe would be crushed in by the superior force of the atmosphere. At many periods this subject has been taken up by philosophers, particularly in the reign of Charles II. For modern inventions under this heading see AËRIAL LOCOMOTION; AERODROME; AEROPLANE; BALLOONS; LANGLEY, S. P.; SANTOS-DUMONT.

Flying Mouse. See PHALANGER.

Flying Phalanger. See PHALANGER.

Flying-squid, a squid of the genus *Ommastrephes*, having two large lateral fins, which enable it to leap so high out of the water that sometimes these mollusks fall on ships' decks. See SQUID.

Flying Squirrel, a small squirrel with soft, dense fur; the skin on the sides capable of being drawn out by extending the legs, so as to form a "parachute," like that of the bat. There are various species native to America, Europe, and Asia, all falling within two genera, *Pteromys*, and *Sciuropterus*. In the latter genus are the European and American flying squirrels. The American species (*S. volucella*) is found from Maine to Florida and westward to the plains. It is entirely nocturnal in habits, and so closely resembles, in color, the bark of the dead trees wherein it makes its home that it is well-nigh invisible. Hence, less is known of it than of other squirrels. Yet when caught it proves to be a gentle, soft-eyed little creature easily tamed. All flying squirrels live in the woods, and gnaw into decayed tree-trunks, where such are obtainable, to make their nests. They feed on nuts, leaf-buds; and, sometimes, on birds' eggs, and even on small birds. Their sailing flight may extend as far as 60 feet, and they cover this distance with a rapid, graceful motion. Wherever found, flying squirrels seem to be fairly numerous, except in Alaska, where one species is found, but is very rare.

Flynt, Josiah. See WILLARD, JOSIAH FLYNT.

Flysnapper, a remarkable bird (*Phænopepla nitens*) of the southwestern United States, which belongs to the wax-wing family (*Ampelidæ*), but has the shy yet active movements of a flycatcher with a habit of jerking its tail. The male is shining bluish-black, with white wing-quills and vent, and a noble crest; his mate is gray, brown and white. It catches insects on the wing, by leaping from its perch and snapping at them noisily; but also eats mistletoe berries, etc. It makes a shallow nest in a low tree and lays eggs with dark dots about the small end. The term "flysnapper" is also given to some of the smaller flycatchers (q.v.).

Fly-wheel, a wheel employed in machinery, which by means of its great momentum renders equable and regular the motion which is generated by an irregular or intermittent force, or meets with an irregular or intermittent resistance. In order to effect this object its rim is made heavy, its circumference proportionately long, and it is hung on the revolving shaft of the machine it controls. Thus by its inertia it opposes any sudden acceleration of speed, and by its accumulated momentum it prevents sudden diminution of speed; acting in the latter case as a store of power to continue the movement when the motor temporarily flags, or in passing dead centres when the motor is inoperative.

Fo, the name given by the Chinese to Buddha. Originally, the name Buddha was expressed in the Chinese language with sufficient exactness by the term *Fô-thau,* pronounced *Fôudah;* but, as is usual in China with proper names, the last syllable was subsequently dropped. See BUDDHISM.

Foa, Eugénie, ė-jā-nē fōä, French author: b. Bordeaux 1708; d. 1853. Her maiden name was Fradis, and she was of Spanish-Jewish descent. Separated from her husband she supported herself by her pen, often writing under the name "MARIA FITZCLARENCE." Her tales for young children are delightfully clever. Notable among her works are: 'Les Mémoires d'un Polichinelle' (1839); 'Le Petit Robinson de Paris' (1840); and 'Le Vieux Paris' (1840).

Focus, a word introduced into science by Kepler in 1604. It literally means a hearth, round which all the members of a family gather, and takes the acquired meaning of the centre, into which certain activities are gathered. In optics it denotes the point at which divergent rays of light are brought to meet again, and from which they appear to proceed. The principal focus of a lens is the focus of rays falling upon the lens in a line parallel to its axis. The conjugate foci of a mirror or lens are two points so situated that the rays emitted from a light, or a luminous object, at either point, are reflected or refracted to the other. In photography the word is familiarly used of the image reflected on the screen of ground glass, which is said to be in focus when it is fixed at a true focal point, and so as to procure a focal or undistorted effect. It is also used of the lens, with regard to its distance from the screen of ground glass. The lens is in focus when it transmits to the screen an image without blurring or aberration. See LENS; LIGHT; MIRROR; OPTICS.

The term is employed in geometry in the description of the ellipse, which has two foci, of which it can be proved that the sum of the distances of any point of an ellipse from its foci is constant, and the difference of the distances of any point of a hyperbole from its foci is constant.

Fodder (A. S. *fódor,* cog. with Ger. *futter*), the food collected by man for the use of the domestic herbivorous quadrupeds. In English the term is commonly restricted to dried herbage, as hay and straw; but in other languages it is more comprehensive, and includes all the food of cattle, except what they gather for themselves in the field. The principal part of the food of the domestic herbivora is furnished by grasses, most of which are eaten by them when fresh and green. Besides the supplies which they receive of the surplus of corn cultivated for human food, they are also, to a considerable extent, dependent on the straw or dried herbage of the corn-plants for their winter provender; and that of many other grasses, cultivated on this account alone, is converted into hay for their use. Hay, being cut and rapidly dried while the plant is still full of sap, contains more nutritious matter than the ripened straw of the cereals. In the United States the best grasses are timothy, red top or Rhode Island bent, white top, orchard grass, and June grass or Kentucky blue grass. In California the best fodder grass is the alfalfa, of which three or even four crops a year are obtained.

Next to the grasses are ranked the *Leguminosæ,* affording food for cattle in their seeds — as beans, peas, lentils, lupines, etc. — and in their herbage, on account of which many of them are cultivated, as clover, lucerne, vetch, tares, sainfoin, etc. When consumed green, the produce of these crops is usually termed forage or green forage. (See SILAGE.) Some of them enter also largely into the composition of hay, being cut and dried with the grasses along with which they have been sown. Some of the *Cruciferæ* are cultivated to a considerable extent as forage-plants, cattle being fed on their green herbage, although they are not suitable for drying as fodder. Among these are kale and cabbage, rape, etc. In some parts of the world cattle are not unfrequently fed on the leaves of trees, as in the Himalayas, where the leaves of different species of Aralia, Grewia, elm, and oak are chiefly employed for this purpose, and are collected, dried, and stacked for winter fodder. In seasons of drought in India cattle are kept alive on the green leaves and pods of acacia and *Inga dulcis.* See ALFALFA; CLOVER; GRASSES; HAY; PASTURE; etc.

Fodder, Green. See SILAGE.

Fodientia, the aard-varks (q.v.); also EDENTATA.

Fœniculum. See FENNEL.

Foehn (fėn) **Wind,** a warm wind that blows from the Alps in some of the northern valleys of Switzerland. At one time the *fœhn* was supposed to be an air-current that had been warmed by passing over the Desert of Sahara. Now it is known that the *fœhn* is warm because it is a south wind which, robbed of its moisture by expansion and cooling in passing over the Alps is warmed by compression in descending through the increase of atmospheric pressure with decreased altitude. It corresponds to the Chinook wind of Montana, Washington, and British Columbia. See CHINOOK WIND.

Fœtus, fē'tus, **Development of,** the growth of the unborn child from the fourth month until its birth. The convolutions of the brain, distinguishable organs of sex, ossification, and muscular movement advance in the fifth month, during which nails and hair appear. During the sixth month the pubic bones ossify, eyelids and eyelashes form, fat develops under the skin. In the seventh month, the fat increases, the eyelids are open. During the eighth month the nails are fully developed, and the fœtus attains a weight of from 5 to 9 pounds. See also EMBRYO.

Fog, a very thick mist; small hollow vesicles of water suspended in the air, but so low as to be but a short distance from the earth in place of rising high above it and becoming so illuminated by the sun as to constitute clouds of varied hue. Fogs often arise when the air above warm, moist soil is colder than the soil itself. The hot vapors from the ground are then condensed by coming in contact with the colder air above, as the warm steam of a kettle is by the comparatively cold air of a room. But no fog arises till the cold air has absorbed vapor enough to bring it to the point of saturation. Fogs often hang over rivers. Their cause is the condensation by contact with the cold water, of the vapor in a hot and moist air current passing over

the river. The "pea-soup" fogs of London life are produced by the carbon of the smoky atmosphere coloring the fog vesicles; a fog which is brown in London's business district is generally white a few miles off, and wanting altogether at the further extremities of the city. On hills and mountains of any size it is easy to rise above a fog, and see it like an ocean beneath one's feet.

Fog-signals, signals given by means of sound or light to warn vessels of danger during fogs. Various kinds of fog-signals are used, among which may be mentioned bells, drums, gongs, guns, compressed-air whistles, steam-whistles, and fog trumpets or horns, and latterly powerful electric flashlights. Gongs are not very powerful as signals, often failing to be heard at more than the distance of a quarter of a mile. Bells may be heard during fogs at a distance of from 1 to 3 miles. Guns have been heard as far as 10 miles, with a light breeze blowing across the sound. One of the most powerful signals is the siren fog-horn, the sound of which is produced by means of a disk perforated by radial slits made to rotate in front of a fixed disk exactly similar, while a long iron trumpet forms part of the apparatus. The disk is made to revolve rapidly, and when the slits are opposite each other openings are formed through which electricity, steam, or compressed air is forced. This causes a sound of very great power, which the trumpet collects and compresses, and which under favorable circumstances is heard from 20 to 30 miles out at sea. Fog-signals are also used on railways during foggy weather. They consist of cases filled with detonating powder, which are laid on the rails and exploded by the engine when it comes up to them. Bell-buoys, common to the coasts of the United States, are operated by the current, by the ebbing and flowing tide, by the swaying of the waves, by the wind, and by clockwork impelled by weight or spring. As to construction, they are adapted for anchorage on spits, sand-bars, or shoals. The use of electricity in fog-signals is well illustrated at Sandy Hook, N. J., where a powerful searchlight flashes every few moments in varying directions. In clear weather this flashlight can be observed a distance of 50 miles at sea. There are in the United States under government control nearly 10,000 fog-signals of all kinds, 3,000 of which are lighted. Eleven buoys are operated by electric light. Germany erected in 1903 a fast flashing light on the island of Helgoland in the North Sea. The system or principle employed is said to be entirely new. Not only that, but it was said to present absolutely insurmountable difficulties. The revolving light on Helgoland is not only the largest in the world, it is the most unique, for Germans claim that it never had a model.

They built upon the superiority of the German reflector, with its exactly parabolic ground-glass mirror or speculum, and the marvelous success of the Helgoland fast-flashing light has justified German effort, skill, and courage. In these lines, for a long time, France was in the lead. It looks as if she would have to guard her laurels. The reflector invented by Schuckert, with its parabolic mirror, is easily earning a place by the side of the world's very best work. It took a long time to get a hearing for the glass parabolic mirror in the lighthouse world. The bright fires — *feux éclairs* — of the system, based upon a combination of Fresnel lenses and totally reflecting ring prisms, which were built by the French with marvelous skill and accuracy, blocked the way to the new lights. About the middle of the nineties German experts were sent to France by the German imperial government for the express purpose of studying flashlights. The experts stayed long enough to find out all that was best in the French system, aided thereto by the kindness of the scientific men of the republic. Before their return they were convinced that by means of two or more reflectors, erected upon a reflector with Schuckert's glass parabolic mirror, results equal to those of France could be produced.

Experiments were made in Nuremberg. They went far beyond what the most sanguine had believed possible. The revolving reflector of the German apparatus was fully equal to the Frenchman's revolving light. As soon as the experts had demonstrated their point, work was begun on a light reflector or projector equal to the largest ever used. It was to represent 30,000,000 candlepower and to last no longer than one tenth of a second. The flashes must follow each other every five seconds. When the weather is favorable the beams go far beyond the central fires of light rays. On the first night that the new light was used, its peculiar, flashing beams were seen by people standing on the mole at Busum, a distance of 65 kilometres, or a trifle over 40 miles. The watchers in the lighthouse at Amrum, about the same distance, were able in unfavorable weather to see the same beams as they rapidly appeared and disappeared. It was noted that the otherwise bluish-white light of the electric arc appeared red. See BUOY; ELECTRIC LIGHTING; FOG; LIGHTHOUSE; MEGAPHONE; SIREN; TOPOPHONE.

Fogarassy, János, yän'ōsh fō'-gä-rŏsh-ĭ, Hungarian lawyer and philologist: b. Käsmark, in Austria-Hungary, 1801; d. 11 June 1878. He studied at Sáros-Pátak, and was graduated in law, became an advocate, and was appointed to an office in the government bureau of finance. His principal claims upon the memory of posterity are his legal works written in the Hungarian tongue. He also published a 'Hungarian Dictionary' (1836), and began, at the suggestion of the Hungarian Academy, a complete dictionary of the language in collaboration with G. Ezuczor, after whose death he finished the work single-handed. It was published in 1861, and for this achievement he was awarded a gold medal by the Academy.

Fogazzaro, Antonio, än-tō'nē-ō fō-gä-tsä'-rō, Italian poet: b. Vicenza, Italy, 1842. He first came into notice with 'Miranda,' a story in verse (1874), and added greatly to his reputation as a poet with 'Valsonda,' a volume of lyrics (1876). He was author of several novels which were received with marked favor, among them: 'Master Chicco's Fiasco' (1885); 'Daniel Cortis' (1887); 'The Poet's Mystery' (1888).

Fogelberg, Bengt Erland, bengt ĕr'länt fō'-gĕl-bĕrg, Swedish sculptor: b. Grotenburg 8 Aug. 1786; d. Trieste 22 Dec. 1854. He began his art studies in the Academy at Stockholm and in 1820 went to Rome, where he soon made a name. He was among the first to invest the mythologic figures of the North with the graces of the Grecian antique, and the influence

of Thorwaldsen is plainly seen in his 'Odin and Thor' in the museum at Stockholm. He also vied with Thorwaldsen in such purely classic subjects as: 'The Dying Argus'; 'Venus'; 'Cupid and Psyche.' He executed two statues of Gustavus Adolphus, and, in collaboration with Byström, the series of colossal statues of the Swedish kings at Stockholm.

Foggia, fōd'jä, or **Capitanata,** cäp-ē-tän-ä'tä, Italy, a province on the Adriatic, between the provinces of Campobasso and Bari. It possesses rich pastures. Among its special products are wines, saffron, and fruits. The principal town is Foggia. Area, 2,688 square miles. Pop. (1901) 425,450.

Foggia, a city of southern Italy, capital of the province of the same name, in the centre of the great Apulian plain, 46 miles east by south of Campo Basso. It is well built, most of the houses being reconstructed since an earthquake which happened in 1732. It has large storehouses for keeping corn, and is the place where the flocks that feed on the great plain of Apulia are registered. Pop. (1901) 53,151.

Foglar, Ludwig, lood'-vĭg fō'glär, Austrian poet; b. Vienna 24 Dec. 1819; d. Kammer 15 Aug. 1889. Among his poems, mostly lyric, are: 'Cypresses' (1842); 'Sunbeams and Shadows' (1846); 'Clara von Vissegrad,' an epic (1847); 'Freedom's Breviary' (1848); 'Joyful and Sorrowful' (1867); 'Saint Velocipede' (1869), a satire (under the pseudonym "Lebrecht Flott").

Fo'go, Fuego, fwā'go, or **St. Philip,** (1) One of the Cape Verde islands, in the Atlantic Ocean, and the highest of the group, being 9,760 feet above sea-level, and presenting the appearance of one single mountain, though, on the sides, there are deep valleys; area, 170 square miles. Pop. estimated at 16,000. It has no rivers, and a scarcity of fresh water prevails, yet it is one of the most fertile islands of the archipelago, producing excellent maize and fruits. The chief town is Nossa Senhora da Luz. (2) Fogo, a port of entry and capital of Fogo Island, Newfoundland, at the southwest entrance to Notre Dame Bay, 122 miles northwest of St. John's, N. B. Pop. (1901) 1,118.

Fohi, fō'hē, the first Chinese emperor and legislator. He is said to have founded this kingdom 2,207 B.C. Nothing certain is known of his reign; but there are attributed to him the institution of marriage, the invention of fishing, hunting, music, and writing. He acknowledged and worshipped a supreme deity. He is supposed to be the Noah of the Bible.

Föhr, fėr, Germany, an island of Schleswig, in the North Sea; area 31 square miles. The town of Wyk is a fishing centre. The population numbers 4,200, mostly Frisians.

Foil. (1) A leaf or thin sheet of metal placed beneath transparent jewels to heighten their color and improve their brilliancy; also applied to those sheets of tin amalgam placed behind mirrors to make them reflect perfect images. They are made of copper, tin, and silvered copper, and are much used in imitations of precious stones. Colored foils are made by coating the white with any varnish of the required tint. The sheet lead which is used for the lining of tea-chests is a species of foil, and the Chinese purchase about 4,000 tons of lead annually from England for this purpose. (2) In architecture a small arc in the tracery of a window or panel. (3) In fencing. See Fencing.

Foix, Gaston, gas-täṅ fwä, Count de, and Viscount de Béarn, French military officer: b. 1331; d. 1391. Acquired the surname of Phœbus. He spent his life in war and the chase. His first service in arms was against the English in 1345. During the revolt known as la Jacquerie he contributed to the rescue of the Dauphin at Meaux. He wrote a book on the pleasures of the chase, of which several editions were published.

Foix, Gaston de, French soldier: b. 1489; d. Ravenna, Italy, 11 April 1512. He had the command of the army of Italy, and on account of the daring exploits was denominated the "Thunderbolt of Italy." After performing prodigies of valor he was killed at the battle of Ravenna.

Fokien. See Fu-Kien.

Fokshani, fŏk-shä'nē, town in Rumania, population 23,800. Extensive vineyards are in the neighborhood and much wine is produced here. The town is well-known historically. It was destroyed by the Russians in 1789 and by the Turks in 1822.

Fold, in geology, a term used to denote an inclined position into which various disturbances may have moved rocks previously horizontal. Even very brittle rock may be thus folded, rather than broken, under a severe, steady pressure. Three kinds of fold are generally distinguished: (1) monocline, in which the rocks are inclined in one direction only; (2) anticline, in which they are bent up in the manner of an arch; and (3) syncline, in which the arch is bent downward instead of up. Folds are rarely symmetrical. See Dip; Fault.

Folding Machines. The folding of printed sheets for books or newspapers was performed by hand up to 1856, when Cyrus Chambers, Jr., of Philadelphia, invented a practical folding machine, which was manufactured by him and his brother Edwin, who within a few years produced a considerable line of folders of various sizes and capacities. The folding machine of C. S. Forsaith, of Manchester, N. H., designed for folding newspapers only, came out some years later. A good many Stonemetz folders were sold between 1880 and 1890. The leading folders on the American market to-day are the Dexter, the Chambers, and the Brown. The vital principle on which nearly all paper folders are based is the descent of a dull blade on the paper sheet at the point where the fold is to be made, the blade thrusting the paper between rotating rollers, which draw it in folded. The making of a second fold is accomplished in the same way, the paper being passed along by traveling tapes from one stage to another, up to three or four folds. The earlier machines were not positive in their register, that is, the fold was apt to vary slightly in position, but the modern machines are very accurate, and large 64-page sheets are commonly folded on the machines with entire satisfaction. The heavy coated paper introduced about 1890 to 1895 developed a tendency to buckle or crease slightly on the last fold of a large sheet, and the most recent folding machines have introduced devices to overcome this difficulty. The most conspic-

uous improvement of recent years has been the drop-roll, which has added materially to the speed of the machines. This was introduced by Dexter, and enabled the sheet to be fed sideways — that is, the shortest way. Registering by means of points, that slip into holes or slits in the sheet, is another feature of modern machines. The equipping of machines with pasters was accomplished early in the history of the folding machine, and this feature has been brought to a high degree of perfection. The paste is held in fountains and laid on the paper in strips as it passes by.

Folders are now made in so many styles that the mere enumeration of them requires considerable space. They may be either drop-roll or point-feed; there are quadruple 16s and double 32 folders, some of which insert one sheet within another; there are marginal folders for books and pamphlets and for jobbing work; also large single and combination periodical folders, rapid circular folders, plain circular folders, jobbing circular folders, and various so-called newspaper folders. Then there are special newspaper and periodical folders, combinded folding and wire-stitching machines, combined folding and feeding machines, and combined feeding, folding and wire-stitching machines.

The Dexter combined folding and wire-stitching machine was introduced in 1897, and it is continuous and strictly automatic. It takes the sheets from the platforms of the feeders, and folds, gathers, collates, covers, and wire-stitches, delivering completed copies without intermediate handling.

There are various other combinations and arrangements for special work, which, together with those above named, have greatly reduced the cost of binding books, pamphlets, and periodicals.

On fast web newspaper printing presses there is used a rotary type of folder, that was brought out by the Hoes, and controlled by them for many years, being probably their most valuable patent in connection with these presses. Three folding blades were mounted on a single cylinder, catching the paper three times in a single revolution, thus securing immense speed. The device is not accurate enough for book folders, but it made possible the enormous speeds obtained by the so-called lightning newspaper presses.

The job folding machines for doing odd work of varying sizes, have come into extensive use within a few years. They are small and comparatively simple machines capable of operating at high speed. See AMERICAN NEWSPAPERS.

Földvar, fėld'vär (ancient SUSSUINUM), a walled town of Hungary, on the slope and summit of a hill, on the right bank of the Danube, 49 miles south of Budapest. Pop. (1900) 12,364.

Folengo, Teofilo, tā-ō'fē-lō fō-len'gō (pseudonym «MERLINO COCCAJO»), Italian poet: b. near Mantua, Italy, 8 Nov. 1491; d. near Bassano, Italy, 9 Dec. 1554. He was the first to win fame as a writer of macaronic verses. His 'Macaronic Work of Merlino Coccajo, Mantuan Poet' (1517–25) comprises the comico-heroic poems, 'Baldus' and 'Moscæa' (War of the Midges). His satire is mostly against monachism. He writes in cynic humor, but under his burlesque lies a vein of serious purpose. Under the pseudonym «LIMERNO PITOCCO» he wrote in Italian the epic satire 'Orlandino' (1526), in ridicule of the story of 'Roland'; then, partly in macaronic, partly in pure Italian, partly in pure Latin, 'The Chaos of Three by One' (1527), in which he darkly recounts the events of his own life.

Foley, John Henry, Irish sculptor: b. Dublin 24 May 1818; d. Hampstead, England, 27 Aug. 1874. His 'Ino and Bacchus' (1840) attracted much notice, and was followed by a succession of admirable classical and ideal works, including: 'A Youth at a Stream'; 'Caractacus'; and several excellent subjects from Shakespeare. The most noteworthy feature of his work, however, was his careful and artistic execution of his statues and busts, which incuded the Hampden and Selden figures in St. Stephen's Hall, Westminster; Goldsmith, Burke, and O'Connell, in Dublin; and the equestrian statues of Lord Hardinge and Sir James Outram, for India, which rank among the finest equestrian sculptures of modern times. The statue of the Prince Consort for the Albert Memorial is also Foley's work, and one of his latest works was a bronze statue of Stonewall Jackson for the State of South Carolina.

Folger, fōl'jėr, **Charles James,** American jurist: b. Nantucket, Mass., 16 April 1818; d. Geneva, N. Y., 4 Sept. 1884. He was graduated at Hobart College in 1836; and admitted to the bar in Albany, N. Y., in 1839. He became judge of the court of common pleas of Ontario County in 1843; was a member of the State senate in 1861–9; elected associate judge of the State court of appeals in 1871; succeeded to the chief justiceship of that court in 1880; and was secretary of the United States treasury in 1881–4. In November 1882 he was the Republican candidate for governor of New York, but was defeated.

Folger, Peter, American colonist and author: b. England 1617; d. Nantucket 1690. He emigrated from Norwich, Norfolk, to America and settled at Martha's Vineyard in 1635. He was grandfather of Benjamin Franklin, his daughter Abia having married Josiah Franklin and borne the illustrious statesman and philosopher among her 17 children. He was clerk of the courts in 1673 and possessed a literary sprightliness which descended to his grandson, as may be seen from a perusal of his 'A Looking-glass of the Times, or the Former Spirit of New England Revived in this Generation' (1875).

Folgore, fōl'gō-rā, Italian poet. He flourished at the end of the 13th century, but the dates of his birth and death and the incidents of his life are unknown. He wrote a number of sonnets, all of which have been translated into English by Dante Rossetti and J. A. Symonds. Their poetic merit is far from contemptible, and they are particularly interesting from the vivid light which they throw on Italian society. Their prevailing tone is one of refined epicureanism, and their style is mainly remarkable for affluence of imagery. «Every line,» says Mr. Symonds, «presents a picture, and each picture has the charm of a miniature fancifully drawn and brightly colored on a missal marge.' See Rossetti, 'Dante and His Circle' (1874); and Navone, 'Le Rime di Folgore' (1880).

Folia'tion, a term restricted by Darwin, and subsequently by geologists, to the arrangement of the constituent portions of a rock in alternating and more or less parallel layers or folia of different mineralogical nature. It differs from cleavage (q.v.), which is applied to certain superinduced divisional planes that render a rock fissile; and from lamination, in which the planes of separation in a rock are the result of deposition in successive layers. If foliation postdate the formation of the rock, the structure is practically the same as that known as schistose. The folia are conspicuously lenticular, thickening and thinning out, and reappearing after an interval on the same or a different plane. These alternately lenticular folia are usually more or less closely welded or felted into each other, so that they are not readily separable; and they frequently present the appearance of being puckered or crumpled. The crystalline texture and the foliated character of the schists distinguish them at once from any ordinary bedded "fragmental rock." See SCHIST; SCHISTOSE.

Folio, (1) in printing: *a*. The running number of the pages of a book. The even folios are on the left-hand pages, the odd upon the right. The folios of prefatory matter are frequently in lower-case Roman numerals. *b*. A sheet of paper once folded. *c*. A book of the largest size, whose sheets are folded but once, four pages to the sheet; hence it is used generally for any large volume or work. (2) In bookkeeping, a page or opening in an account book. (3) In law, a certain number of words in legal documents. The number varies in the States; thus in some of them, as in England, in law documents, conveyances, deeds, etc., the folio is 72 words; in chancery and parliamentary proceedings 90 words. In New York and other States 100 words constitute a folio.

Fo'lium of Descartes, dā-kart, in mathematics, a curve such that the simultaneous increments of two lines drawn from the generating point of the curve to two fixed points, have always to each other a constant ratio. If the ratio is equal to -1, the oval becomes an ellipse; if it is equal to $+1$, it is an hyperbole.

Folk, Joseph Wingate, American lawyer and political leader: b. Brownsville, Tenn., 28 Oct. 1869. He was graduated at Vanderbilt University, studied law, and was admitted to the bar in 1890. Later he removed to Missouri, where he became prominent in his profession and in political life. As district attorney at Saint Louis, he was active in exposing political corruption and punishing the offenders. Owing to his efforts nearly 20 officers of corporations and city officials were convicted of bribe giving and taking; and afterwards similar corrupt practices in the State legislature were exposed. His fearlessness in attacking a long established evil and his success in accomplishing results won for him the confidence and admiration of the people of the State, and in 1904 he was nominated for governor by the Democratic Party in spite of the opposition of the party machine. He was elected governor of Missouri by a good majority, though the State went Republican in the national election at the same time.

Folk-lore, the science which embraces all that relates to ancient observances and customs, to the notions, beliefs, traditions, superstitions, and prejudices of the common people. Gomme's divisions are: (1) Traditional narratives: (a) folk-tales, (b) hero tales, (c) ballads and songs, (d) place legends; (2) traditional customs: (a) local customs, (b) festival customs, (c) ceremonial customs, (d) games; (3) superstitions and beliefs: (a) witchcraft, (b) astrology, (c) superstitious practices and fancies; (4) folk-speech: (a) popular sayings, (b) popular nomenclature, (c) proverbs, (d) jingle rhymes, riddles, etc.

Folk-lore had been observed and noted by countless writers of early days, but it was not till after the beginning of the 19th century that its value for the elucidation of the social history of mankind had become apparent to thinkers, and its systematic study been seriously begun. Meantime the reawakening to natural poetry, and to the beauty of free emotional expression in literature, which lay at the foundation of what it is usual to call romanticism, had already commenced even in the 18th century, and the publication of Percy's 'Reliques of Ancient English Poetry' (1765) had given a powerful impulse to Scott and others in England, to Herder, and to Arnim and Brentano in Germany, who found a rich wealth of traditional poetry, the poetic value of which they fortunately had the eyes to see. But the study of folk-songs really began with Scott's 'Minstrelsy of the Scottish Border' (1802–3). It was perhaps an advantage rather than a disadvantage that the first worker in this new field was but the folk-lorist unawares and mere great poet and romancer of genius that he was; for our folk-poetry would never have enriched and permanently influenced all later English literature but for its own intrinsic and genuine poetic quality, any more than our detached folk-lore facts would ever have risen above the dignity of the whimsical pastime of an idle hour but for their inherent though unsuspected faculty for throwing light backward on the history of human civilization. All, or nearly all, the facts of comparative mythology are to be found in folk-belief in solution; a great many facts of folk-belief are to be found in comparative mythology crystallized. The facts are essentially the same in both cases, but the one study deals with them at one, the other at another stage.

First in importance of the collections of material is still the earliest, the 'Children and House Tales' (1812–14) of the brothers Grimm (q.v.). Grimm's 'German Mythology' (1835) is still unequaled in the range of its erudition and in the systematic thoroughness with which the mythology and superstitions of the ancient Teutons are traced back to the dawn of direct evidence and downward in decay and diminution to the popular tales, traditions, and phrases in which they still unconsciously survive. These two works of Grimm created a school, whose abundant labors later folk-lorists have entered into, while they have enlarged the horizon of the science, because the stamp of soundness and sufficiency so far as it goes is impressed in all the work of Grimm and his successors, of whom, in Germany, the most eminent were Kuhn, Mannhardt, J. W. Wolf, and W. Schwartz. To the English-speaking world Max Müller's essays

revealed a new world of undreamt-of affinities, and the combined charm of their literary grace, wide learning, and rare powers of exposition converted every reader to a theory which, as has been seen, is only now being displaced by another with a sounder basis of real philosophy and facts. Since then the study of folk-lore has become fashionable, indeed almost an article of patriotism, and societies have been formed in most countries to further its study. Of these the most important is still the Folk-lore Society of England, established in 1878, with its official organ, the 'Folk-lore Journal.' The American Folk-lore Society was instituted at Cambridge, Mass., early in 1888: (1) For the collection of the fast-vanishing remains of folk-lore in America, namely: (a) Relics of old English folk-lore (ballads, tales, superstitions, dialect, etc.); (b) lore of negroes in the Southern States of the Union; (c) lore of the Indian tribes of North America (myths, tales, etc.); (d) lore of French Canada, Mexico, etc. (2) For the study of the general subject, and publication of the results of special studies in this department. Already its journal has amply justified its existence by a series of articles of striking originality and value.

Folk-lore, though it takes cognizance of many apparently trivial matters, is of great importance in the science of comparative mythology, and helps to throw much light on the relationships between races, and on the origin and development of religious beliefs and ceremonies. It is, therefore, of great assistance to the ethnologist, the sociologist, and the historian, as well as to the student of comparative mythology and of the science of religion. It has attracted much attention in recent times. See ASTROLOGY; FABLES; FAIRY TALES; LEGENDS; MYTHOLOGY; SUPERSTITION; WITCHCRAFT.

Bibliography. — Aubrey, 'Miscellanies' (1696); Browne, 'Pseudodoxia Epidemica' (1646); Brand, 'Popular Antiquities'; Chambers, 'Book of Days'; Hone, 'Everyday Book'; Hone, 'Year Book'; Lang, 'Custom and Myth'; 'English Folk-lore Journal'; 'American Folk-lore Journal.'

Folk-music. The music of a nation is generally based on folk-music, or the folk-tunes that are handed down from generation to generation along with folk-lore. Hungarian folk-music has provided material not only for native composers but for the Germans. Haydn, Liszt, and Schubert utilized the melodies of the Magyars and the Gypsies. Brahms and others did the same thing in Russia. Beethoven went to Scotland and Ireland for melodies and Puccini traveled as far as Japan for one of his operas. Of all European countries Germany and Ireland have probably the greatest variety of folk-songs. (See FOLK-LORE; MUSIC.) Consult: Engel, 'Study of National Music' (1886); Tinck, 'Songs and Song Writers' (1900); Parry, 'Evolution of the Art of Music' (1896).

Folk-psychology, an ethnological study of the psychology of races and people, differing from folk-lore, which studies survivals. Among modern students of this science are Baldwin, Wundt, Lombroso, Lazarus, Steinthal and Felix Adler. Folk-psychology considers the habitat and food conditions of a people, its somatology, sex, technology, æsthetics, jurisprudence and pathology. Nearly all the books written upon this subject have been published only in German. See ETHNOLOGY.

Folk-right, the native laws and customs in Early English history as distinguished from the rules and observances introduced by William the Conquerer and his followers. See ENGLAND.

Folkestone, or **Folkstone,** fōk'stōn, a fortified seaport town of England, in Kent County, 62 miles southeast of London, and 7 west of Dover. It possesses a spacious harbor and fine pier whence the tidal steamers sail twice a day to Boulogne on the French coast. It was the birthplace of William Harvey (b. 1578), the discoverer of the circulation of the blood. Pop. (1901) 30,694.

Folk'land, or **Folcland,** fok'land, the land of the people, that portion of Anglo-Saxon England which was retained on behalf of the community. It might be occupied in common or possessed in severalty, but could not become allodial estate or absolute private property except with the consent of the Witan or highest council in the land. From time to time large grants were made both to individuals and to communities; and land thus cut off from folcland was called bocland or "book-land." Ultimately the king practically acquired the disposal of it, and the remnant of folkland became crown lands.

Folkmar, Daniel, American anthropologist: b. Roxbury, Wis., 28 Oct. 1861. He was graduated at the Western College of Iowa in 1884 and continued his studies at Paris and Berlin. He subsequently taught in several western institutions of learning (1895–1900) and was professor of anthropology in the Université Nouvelle of Brussels 1898–1901. Among his many writings are: 'L'Anthropologie Scientifique' (1899); and 'Leçons d'Anthropologie Philosophique' (1900).

Folkmoot, fōk'moot', or **Folcmote,** in Anglo-Saxon England, an assembly of the people to consult respecting public affairs.

Folks, fōks, **Homer,** American sociologist: b. Hanover, Mich., 18 Feb. 1867. He was graduated from Albion College (Mich.), in 1889, from Harvard in 1890, was superintendent of the Pennsylvania Children's Aid Society 1890–3, and in 1893 became secretary of the New York State Charities Aid Association. In 1900 he assisted the United States military government of Cuba in reorganizing the public charities of the island. He has written a 'History of the Care of Destitute, Neglected and Delinquent Children in the United States during the 19th Century.'

Fol'len, August, ow'goost, later **Adolf Ludwig,** German poet: b. Giessen, Germany, 21 Jan. 1794; d. Bern, Switzerland, 26 Dec. 1855. He became extremely popular as the author of 'Sons of Fatherland,' a patriotic hymn; 'Malegys and Vivian' (1829), a romance of chivalry; and numerous translations and poetic appeals to the instinct for liberty. He was a brother of Charles T. C. Follen (q.v.).

Follen, Charles Theodore Christian, American professor and Unitarian clergyman: b. Romrod, Hesse-Darmstadt, 4 Sept. 1786; d. 13 Jan. 1840, in the burning of the steamer Lexington, on Long Island Sound. He was educated at

Giessen, and became professor of Latin and history at Coire, Switzerland. His liberalism in politics and theology caused him to be driven from that town, and he was afterward forced to leave Basel, where he lectured on law and metaphysics, for the same reason. He finally took refuge in the United States and for five years (1830–5) was successful as professor of German at Harvard. He then took charge of the First Unitarian Church of New York, a position which he retained for a year (1836–7). He removed to East Lexington, Mass., in 1839.

Follen, Eliza Lee Cabot, American author: b. Boston, Mass., 15 Aug. 1787; d. Brookline, Mass., 26 Jan. 1860. She was married to Charles T. C. Follen (q.v.) in 1828. She published: 'Poems' (1839); 'Twilight Stories' (1858); 'Home Dramas' (1859), etc.

Folly Island, a small island off the coast of South Carolina, in Charleston harbor. It is separated from the mainland by Folly Island channel. It was the scene of several engagements during the Civil War.

Folsom, Charles, American scholar: b. Exeter, N. H., 1794; d. 1872. He was graduated from Harvard in 1813, was in the navy as chaplain and midshipmen's instructor in mathematics, was tutor at Harvard in 1821–3, and librarian in 1823–6. In 1824 he was associated with William Cullen Bryant in the editorship of the 'United States Literary Gazette.' As a member of the printing firm of Folsom, Wells & Thurston he long prepared for the press the classical works used at Harvard. Publications: An edition of Cicero's selected orations (1811), and an edition of selections from Livy (1829).

Folsom, Charles Follen, American physician: b. Haverhill, Mass., 3 April 1842. He was graduated from Harvard in 1862, was in the Southern States in connection with the Freedmen's Bureau from 1862 to 1865, and after study in the Harvard Medical School practised medicine in Boston from 1870. In 1877–82 he was lecturer in hygiene at Harvard, and in 1879–88 lecturer in and assistant professor of mental diseases. Among his writings is a volume on 'Mental Diseases.'

Folsom, George, American antiquary: b. Kennebunk, Maine, 23 May 1802; d. Rome, Italy, 27 March 1869. He was graduated 1822, studied law, and removing to New York in 1837 became librarian of the New York Historical Society. He was a member of the New York State senate 1844–8, and was appointed *charge d'affaires* at the court of the Netherlands 1850–4, and was for some years president of the American Ethnological Society. Among his publications are: 'History of Saco and Biddeford, Maine' (1830); edition of the 'Collections of the New York Historical Society' (1841), translation of 'Despatches of Hernando Cortes'; 'Political Condition of Mexico' (1843); 'Documents Relating to the Early History of Maine' (1858).

Folsom, Joseph L., American soldier: b. Meredith, N. H., 19 May 1817; d. San José, Cal., 19 July 1855. He was educated at West Point, and served four years in Florida against the Indians (1840–4), and in California in the Mexican war. He communicated officially to the government the discovery of gold in that State; and Folsom City on the American River, near the earliest found gold deposits, is named after him, as one who became identified with the development of the State and especially of San Francisco, where he was a large property owner.

Folsom, Nathaniel, American soldier and statesman: b. Exeter, N. H., 1726; d. there 26 May 1790. He was in command of a company at Fort Edward 1755, and of a regiment later, being brigadier-general of the New Hampshire Contingent in the siege of Boston, and was elected to the Continental Congress 1774–5 and 1777–80.

Foltz, Philipp von, fē'lēp fōn fōlts, German painter: b. Bingen 11 May 1805; d. Munich 5 Aug. 1877. At Munich he was a pupil of Cornelius, whom he assisted in the decoration of the Glyptothek and the arcades in the Hofgarten. He was later a professor in the Academy, and in 1865–70 director of the Centr l Gallery. His historical paintings are minute and faithful in detail and skilfully designed in their pictorial arrangement, but they fail of proper effect from stilted drawing and dryness of color. The Cologne Museum possesses his 'Minstrel's Curse' (after Uhland's ballad); the Maximilianeum, Munich, his 'Humiliation of the Emperor Frederick I. before Duke Henry the Lion,' and 'Pericles attacked by Cleon and his Followers.'

Fol'well, William Watts, American educator: b. Romulus, Seneca County, N. Y., 14 Feb. 1833. He was graduated at Hobart College, later becoming assistant professor of mathematics there; was appointed professor of mathematics at Kenyon College, Ohio, 1869, becoming president of the University of Minnesota the same year, later, professor of political economy there. Author of 'Public Instruction in Minnesota' (1875); 'Lectures on Political Economy.'

Fond du Lac, fŏn'do-lăk, a city and county-seat of Fond du Lac County, Wis., on Winnebago Lake, at the mouth of Fond du Lac River, and on the Chicago, M. & St. P., the Chicago & N. W., and the Wisconsin C. R.R.'s; about 60 miles northwest of Milwaukee. Fond du Lac was first settled in 1836 by Germans; became a village 1 March 1847, and a city in April 1852.

Industries, etc.— Fond du Lac has important manufactures and is noted for its dairy and agricultural products. The chief industries, besides agriculture, are lumber, grain, flour, leather, paper, machinery, refrigerators, sash and doors, shoes, wagons, furniture, shirts, etc. The city has four banks, with a combined capital of $500,000, and an annual business of $15,000,000.

Buildings, Churches, etc.— The principal buildings are the Carnegie Public Library, Elks' Club House, Saint Mary's Springs Sanitarium, Saint Agnes' Hospital, and Henry Boyle Roman Catholic Home for the Aged. The city has also an excellent public school system (10 buildings), a parochial school and a cathedral school.

Government.— The city is governed by a mayor, elected annually, and a council of 32 members elected biennially, half each year. Pop. (1900) 15,110; (1903 est.) 16,037.

E. M. Jenison,
Editor 'Daily Commonwealth.'

Fon'da, N. Y., a town and county-seat in Montgomery County, on the New York C. & H. R. R.R. It is a thriving centre of a large agri-

cultural district, has one bank and several newspapers. Pop. (1900) 1,190.

Fondi, fōn'dē, the ancient FUNDI, a town of Italy, Naples, in the province Terra di Lavoro, near a lake to which it gives name. It is a bishop's see, and contains a cathedral. The Lake of Fondi (ancient *Lacus Fundanus* or *Amyclanus*) lies between the road and the sea; it sends forth noxious exhalations. Pop. (1901) 9,930.

Fonseca, Antonio Manuel da, än-tō'nē-o mä-noo-äl' dä fōṅ-sā'kä, Portuguese artist: b. Lisbon 1796; d. 1893. He studied in the Academy at Lisbon, became a professor there, was in 1839 appointed court-painter and in 1862 was elected corresponding member of the Academy of Fine Arts at Paris. Several of his pictures, which are chiefly of a historical character, were exhibited in the Paris Exposition of 1855.

Fonseca, Juan Rodriguez, hoo-än' rō-drē'geṫh fōn-sā'kä, Spanish ecclesiastic and statesman: b. Toro, near Seville, 1451; d. Burgos 4 Nov. 1524. He passed through many grades of preferment from the archidiaconate of Seville, to the archbishopric of Burgos, where he became *limosiuero* or private chaplain to the king and queen. In 1493 Ferdinand and Isabella appointed him to superintend the preparations for the second voyage of Columbus and practically to administer the affairs of the New World. He became first president of the Council of the Indies (q.v.), organized in 1511. His conduct in the discharge of this office has been stigmatized by modern historians, and he has been charged with shortsightedness, if not with malignity in his treatment of Columbus, Cortes and Las Casas.

Fonseca, Manuel Deodoro da, mä-noo-äl' dā-ō'dō'-ro dä fōṅ-sā'kä, Brazilian soldier and politician: b. province of Alagoas 5 Aug. 1827; d. Rio de Janeiro 23 Aug. 1892. He was educated as a soldier and graduated with the rank of sub-lieutenant of artillery in 1849. He saw active service in the Paraguayan war (1868–70), and attained the rank of major-general. In 1887, although a conservative and personally attached to the Emperor Dom Pedro II., he and others felt bound to protest against the acts of the government. They were punished for insubordination, revolted, and proclaimed a republic, which was recognized by the United States and later by the powers of Europe. Dom Pedro was banished and Fonseca was elected president of the government 24 Feb. 1891. In November of the same year he was accused of arbitrary acts and compelled to resign. He was succeeded by the vice-president, Peisoto.

Fonseca Lima e Silva, Manuel da, mä-noo-äl' dä fōṅ-sā'kä lē'mä ā sēl'vä, Brazilian soldier: b. Rio Janeiro 1793; d. 1862. He entered the Portuguese army in Brazil, and was apointed lieutenant-colonel in the struggle which subsequently took place for the independence of the country. Under the new régime the Emperor Pedro I. chose him as lord chamberlain. When Pedro abdicated (1831) Fonseca sided with the Liberals and rose to high rank in the government, being minister of war (1831), minister of the interior (1836), and in 1851 he was apointed general and commander-in-chief of the army.

Fonse'ca, fōn-sā'kä, or **Conchagüa,** cōn-chä'gwa, a bay on the Pacific coast of Central America, the proposed terminus of a projected interoceanic railway through Honduras. It is one of the largest bays in the South Pacific and affords one of the finest harbors in the world.

Font. (1) In church architecture, the vessel which contains the water for baptism. It is frequently sculptured in stone or marble, with richly decorative designs. The form of font with which we are now familiar seems to have been introduced in mediæval churches. In the early Latin Church, from the time of Constantine, baptism was administered in baptisteries, which were buildings separate from but adjoining the church. (See BAPTISTERY.) (2) An assortment of any particular kind or size of type used in printing, each font containing a proportionate number of letters, figures, spaces and punctuation marks. See TYPE.

Fontaine, Pierre François Léonard, pēār fräṅ-swä lā-o-nar fôṅ-tān, French architect and author: b. Pontoise, France, 20 Sept. 1762; d. Paris 10 Oct. 1853. He took the second grand prize of Rome 1785, going to Italy in 1786, and there connecting himself with Percier (q.v.), who, as director of the decorations of the Opera, Paris, called him to his aid, a partnership then being formed which lasted till 1814, when Percier retired. They constructed a beautiful stairway in the Louvre; the Arc du Triomph du Carrousel; the arcades of the Rue de Rivoli as far as the Rue de l'Echelle. He retained the favor of Louis XVIII. and Louis Philippe, constructing the Galerie d'Orleans at the Palais-Royal, the Chapelle Expiatoire, the Chapelle Ferdinand, repairs of the Louvre and the Tuileries, and the hospital at Pontoise. He wrote: 'L'Histoire du Palais-Royal'; and, in collaboration with Percier, 'Palais, maisons et autres edifices de Rome moderne' (1802); 'Choix des plus celebres maisons de plaisance de Rome et ses environs' (1809–13); 'Descriptions de cerémonies et de fêtes' (1807–10); 'Recueil des decorations intérieures' (1812–17); 'Residences des souverains' (1833).

Fontainebleau, fôṅ-tān-blō, a town of France, in the department of Seine-et-Marne, and in the midst of the forest of same name, about 2 miles from the left bank of the Seine, and 37 miles east of Paris. It is well built, partly of stone and partly of brick, with spacious and regular streets; is the seat of a court of first resort, and several public offices; contains fine barracks, a communal college, school of design, public library of 28,000 volumes, public baths, and several hospitals; and has manufactures of calico, porcelain, and stoneware; quarries of sandstone, extensively used in paving the streets of Paris and the roads of the surrounding districts; and a trade in wine, fruit, preserves, cattle, etc. Pop. (1901) 14,160. The castle or palace of Fontainebleau, from which the town derives its chief importance, is one of the most magnificent in France. Many of its sovereigns have made it their favorite residence, and vied with each other in lavishing upon it all the embellishments that art could furnish, without any limitation as to expense. Henri IV., Louis XIV., Napoleon I., Louis Philippe, and Napoleon III. all expended large sums upon it. It is now a summer residence of the president of the republic.

Fontainebleau, School of, a group of artists assembled at Fontainebleau in France by Francis I., where they were employed in decorating the palace. There were two branches, Flemish and Italian; the influence of the latter, led by Rosso dei Rossi (1495–1541), eventually dominated French art (q.v.). See FRANCE: *Painting and Sculpture.*

Fontana, Carlo, kar'lō fōn-tä'nä, Italian architect: b. Brusciato, Italy, 1634; d. Rome 1714. He was a pupil of Bernini. While still very young he executed important commissions, including the Grimazzi and Bolognetti palaces, the monument of Queen Christina of Sweden in St. Peter's, and the fountains of St. Peter, and Santa Maria in Trastavere. He also built the cathedral at Fulda. Among his published works are: 'Il Tempio Vaticano e sua origine, con gli edifici piu cospicui antichi e moderni' (1694); 'Ultissimo Trattato delle acque correnti' (1697); 'L'Anfiteatro Flavio' (1725).

Fontana, Domenico, dō-men-ē'kō, Italian architect: b. Mili, Italy, 1543; d. Naples 1607. Cardinal Montalto (afterward Pope Sixtus V.) engaged him to construct a chapel in the Church of Sta. Maria-Maggiore, and a palace in the garden of the same church. But the pecuniary resources of the cardinal failed and the undertaking would have been interrupted had not Fontana himself supplied the means for continuing the work. Sixtus V. wished to remove the great obelisk now in front of St. Peter's Church, which was then nearly buried under the rubbish, to the middle of the square. Fontana happily executed this gigantic operation in 1586. Among other buildings erected by Fontana by the command of Sixtus V., the library of the Vatican and the aqueduct (*acqua felice*), deserve particular mention. Having been accused of converting to his private use the money received for public purposes, he was deprived of his office by the Pope, but immediately received the offer of the post of architect and chief engineer of the king of the Two Sicilies, and in 1592 went to Naples. He there constructed several canals to prevent inundations, a new road along the bay, and the royal palace in the capital.

Fontana, Felice, fā-lē'chā, Italian physiologist: b. Pomarolo, in the Italian Tyrol, 1730; d. 1805. He was appointed professor of natural philosophy in the University of Pisa, and while retaining this position he formed the museum at Florence which contains an immense number of anatomical preparations in colored wax, which exhibit all parts of the human body in the minutest detail, and in all imaginable positions. They are executed with the greatest skill, and were made by different artists under the direction of Fontana. Fontana wrote several works on scientific subjects, some of which have been translated into German and French. He also made discoveries relative to the application of carbonic acid, and different sorts of gas. He was buried in the Church of Santa Croce by the side of Galileo and Viviani.

Fontane, Marius, mä-rios fôn-tän, French writer and administrator: b. Marseilles 4 Sept. 1838. He met Ferdinand de Lesseps in the Orient and became his secretary, shortly afterward being appointed chief of exploitation and secretary-general of the Suez Canal Company and later administrator and member of the Committee of Direction of the Panama Canal Company. He was implicated with the other officers in the downfall of that company, was condemned in 1893 to two years' imprisonment, but this verdict was set aside on appeal, and after another trial he was acquitted. Among his works are: 'Les Marchands de Femmes' (1863); 'Confidences de la vingtieme annee' (1863); 'Selim l'egorgeure' (1865); 'Zara la rebelle' (1866); 'La Guerre d'Amerique' (1866); 'Le Canal maritime de Suez' (1869); 'Essais de poesie vidique' (1876); 'L'Histoire universelle' (Vol. I. 1881, Vol. X. 1899).

Fontane, Theodor, tā'ō-dōr fōn-tä'nĕ, German author: b. Neuruppin, Prussia, 30 Dec. 1819; d. Berlin 21 Sept. 1898. Among his writings are three volumes on England, one 'A Summer in London' (1854); 'The Sleswick-Holstein War of 1864' (1866); 'The War with France' (1876); and other war histories. His first volume of lyrics, 'Men and Heroes,' was published in 1850; his collected 'Ballads' in 1892. He wrote stories of North German life, as 'Count Petöfy'; 'Under the Pear-Tree' (1885); 'Mrs. Jenny Treibel' (1892).

Fontanes, Louis, loo-ē fôn-tän, MARQUIS DE, French writer: b. Niort, Poitou, 6 March 1757; d. Paris 17 March 1821. He went in 1777 to Paris, where he acquired a reputation by his poems: 'Le Cri de mon Cœur' (1778); 'Le Verger' (1788); 'L'Essai sur l'Astronomie' (1789); and 'L'Epitre sur l'Edit en Faveur des Non-Catholiques' (1789). He also wrote a metrical translation of Pope's 'Essay on Man' (1783). In 1802 he was made a member, and in 1804 president, of the legislative body. His admiration of Napoleon was great; and his oratorical talents were often employed in eulogizing the emperor's acts. In 1810 he entered the senate, and, passing on the fall of Napoleon into the service of the Bourbons, was raised to the peerage by Louis XVIII. His writings, prose and poetic, which are regarded as models of elegance and correctness, were edited by Sainte-Beuve in 2 volumes in 1837, with a critical and biographical memoir.

Fontarabia. See FUENTERRABIA.

Fontenelle, Bernard le Bovier de, bär när lė bō-vyā dė fônt-nel, French poet and miscellaneous writer: b. Rouen 11 Feb. 1657; d. Paris 9 Jan. 1757. Although he lived to the age of nearly 100 years, and retained, till his death a remarkable degree of activity, he came into the world so weak that it was not thought possible that he could survive. In 1674 he went to Paris, and soon became known by his poetical effusions and learned works. Before the age of 20 he had assisted in the composition of the operas of 'Psyche' and 'Bellerophon,' which appeared under the name of his uncle, Thomas Corneille (q.v.). In 1683 appeared his 'Dialogues of the Dead,' which were favorably received, although his continual straining after wit and novelty deprives them of the charm of natural ease. His 'Entretiens sur la Pluralité des Mondes' (1686) was the first book in which astronomical subjects were discussed with taste and wit.

Fontenoy, fônt-nwä, **Battle of,** one of the most famous battles in the war of the Austrian succession. It was fought at a small village of the same name, in western Belgium. Here 11

May 1745, the French under Marshal Saxe defeated the Allies under the Duke of Cumberland, with very heavy loss on both sides.

Fontevrault, fôṅt-vrō, a commune of France, in the department of Maine-et-Loire, with 3,581 inhabitants, situated in the middle of a forest occupying a valley in which flows a perennial fountain, 10 miles southeast of Saumur. This valley is celebrated as the site of the rich Benedictine abbey founded by Robert d'Arbrissel in 1099.

Fontevrault, Order of, a branch of the Benedictine order of monks; so named from the place in France where the first monastery of the sect was erected. The order was started in the 12th century by Robert of Abrissel, who brought monks and nuns under one roof, and placed them under the government of a female, because Jesus placed John in subjection to the Virgin Mary, saying: «Woman, behold thy son» (John xix. 26). The founder of the monastery was suspected of immorality, a charge which his followers strenuously denied. In 1106 the order received the sanction of Pope Pascal II.; in 1113 it was exempted from episcopal jurisdiction. In 1177 some monks connected with it came over to England by invitation of Henry II. It was remodeled in 1507 by the Abbess Renée of Bourbon.

Fonvielle, Wilfried de, wēl-frēd dė fôṅ-vyēl, French scientific writer: b. Paris 21 July 1824. He aimed to popularize scientific truths by his writings, of which the best known are: 'Fossil Man' (1865); 'Balloons in the Siege of Paris' (1871); 'The Physics of Miracles' (1872); 'The Conquest of the North Pole' (1877); 'The Wonders of the Invisible World' (5th ed. 1880); 'Thunders and Lightnings' (4th ed. 1885); 'History of the Moon' (1885); 'Hypnotizers' (1887); 'The South Pole' (1888); 'Famous Vessels' (1890); besides one or two minor historical works.

Fonviz'in, Denis Ivanovich, Russian author: b. Moscow, Russia, 14 April 1745; d. St. Petersburg 12 Dec. 1792. His fame as the Molière of his country arises from two comedies: 'The Brigadier' (1766), and 'The Minor' (or 'Mother's Favorite Son') (1782). He wrote also a burlesque, 'Court Grammar,' and mock correspondence of a facetious sort.

Foochow, foo-chow', or **Fu-Chau,** town in China, capital of the province of Fu-Kien, in a plain surrounded by an amphitheatre of hills, on the left bank of the Min, 125 miles northeast of Amoy. It consists of the town proper, surrounded by walls, and of extensive suburbs, which, stretching along both sides of the river, communicate by a stone bridge. The walls, 30 feet high and 12 feet wide at top, are overgrown with grass, and the gates, seven in number, are overlooked by high towers. The streets are extremely dirty, and the lines of shops, crowded with goods or with workmen in the act of making them, make the whole place look like one vast series of market-stalls. The principal edifices are the Ching-hwang Miau, and several other temples. Foochow is one of the five ports thrown open by the Treaty of 1843. The trade is very extensive, but the navigation of the river from the sea to the harbor is difficult. Principal exports — timber, bamboo, fruits, tobacco, potash, paper, and especially for the foreign trade — tea. In 1900 the exports amounted to $3,889,490. The imports in 1900 were of the total value of $4,088,560. Pop. (1900) 650,000.

Food, any substance which, taken into the body, is capable of sustaining or nourishing, or which assists in sustaining or nourishing the living being. Foods may be classed under three heads, gaseous, liquid, and solid, the first two consisting of the air we breathe — the oxygen of which is so essential to life — and the water we drink. Milk, tea, coffee, cocoa, etc., are popularly called liquid foods, but each of these is simply water in which various solid substances are dissolved, or held in suspension. The solid foods are of three kinds — namely: nitrogenous, non-nitrogenous, and mineral. Nitrogen compounds, or flesh formers, are essentially composed of carbon, hydrogen, oxygen, and nitrogen. They possess the only ingredients capable of building up and repairing the nitrogenous tissues of the body, but they also furnish a limited supply of heat, especially when heat-giving compounds are deficient in the body. Nitrogenous compounds are found both in the animal and vegetable kingdoms under the forms of albumen, fibrin, casein, gelatine, and chondrin. Non-nitrogenous compounds, or heat givers, sometimes called carbonaceous compounds, are composed of carbon, hydrogen, and oxygen. They serve to keep up the heat of the body, and so produce energy or force; but they contribute also to the repair and growth of the body. The chief heat givers are starch, sugar, and fat. None of these substances will of itself sustain life. The mineral foods are the salts of soda and potash, the phosphates of lime and magnesia, iron, etc. Common salt is the only mineral substance purposely added to food, the other mineral substances being found in nearly all parts of plants and animals used as food. Milk is a natural model food, as it furnishes all the nourishment required, and in due proportion. Oatmeal may also be called a model food, as it contains one part flesh formers and 5½ parts of heat givers. In fine wheaten flour the proportion is as one to eight, a part of the flesh-forming body having been removed in its preparation. The adulteration of any article of food reduces one or both of its essential constituents. The National Pure Food Law, which went into effect in the United States 1 Aug. 1900, was aimed against adulteration (q.v.). For a more extended description and classification of foods see the article NUTRITION.

Food of Plants. See PLANT FOODS.

Food-poisoning, a form of poisoning from food, which in times past was thought to be extremely common, but at the present time is known to occur but rarely. One of the most important features in food-poisoning is individual idiosyncrasy. It is well known that certain foods, such as strawberries and tomatoes, affect susceptible people uncomfortably, but instances of this are rare, and are often of mental origin. Epidemics of food-poisoning have occurred, as when, for instance, a baker has used a yellow coloring matter in his cake to obviate the necessity of using eggs, which coloring matter was largely made up of lead.

Food-poisoning may be classified under three main types: (1) Poisoning by means of

metals; (2) poisoning by means of animal parasites; (3) poisoning by means of plant parasites, bacteria and fungi and allied organisms. The metals which have been known to cause poisoning in food are particularly arsenic, lead, copper, antimony, tin, and zinc. During 1900 there was a widespread epidemic from poison by arsenic, in Manchester, England, and neighboring cities, from the drinking of beer. On investigation it was found that the arsenical poisoning, which in some cases proved fatal, was due to the glucose used in the manufacture of the beer. This glucose had been prepared by a sulphuric acid which had in turn been made from iron pyrites containing large amounts of arsenic. It entered into the glucose, and thus became an ingredient of the beer. This epidemic was extremely severe, thousands of cases of arsenical poisoning having been observed. Lead-poisoning very frequently follows the use of water which has been conveyed through new lead pipes. It may also result from the use of leaden coloring matters used in bread, biscuit, cake, etc. Zinc and copper poisoning have resulted from the use of canned vegetables, copper frequently being used to impart a good color to the vegetable.

Food-poisoning resulting from animal parasites or from animal poisons are of extreme interest. Trichinosis from the flesh of hogs, which has been imported in pork and pork sausages, while rare in this country, is common among those people who habitually eat their sausages without thorough cooking. A form of poison results from the eating of mussels which have developed the ptomaine mytilotoxine, and similar forms of poisoning from decomposition products in meat have been observed. A special form of meat-poisoning, botulism (q.v.), is extremely common in certain countries. It seems to be due to the development of the *Bacillus botulinus*. This form of poisoning has been observed in those who have eaten ham. The symptoms are late in onset; from 24 to 36 hours after eating gastric pains with frequent vomiting occur; and constipation is at first obstinate. Practically all the cases of botulism have shown eye-symptoms. There is disturbance of vision, the eyes become fogged, the lids droop, people see double, and there is dilatation of the pupils, while burning thirst and constriction of the throat are frequent signs. Extreme muscular weakness with perhaps loss of ability to speak, or of power to empty the bladder, may develop.

Other forms of food-poisoning have been described resulting from eating sausages and other meats which were diseased at the time of killing, or which have become tainted afterward, and a number of poisonous bacteria have been isolated. *Bacillus enteritidis, Bacillus morbificans, Bacillus breslaviensis, Bacillus Friedebergensis*, have been some of the forms that have been obtained in poisonous meat. Fish-poisons are not unknown, and in Russia and Switzerland and the West Indies a number of cases have been described as resulting from fish-poisoning. A peculiar type of poisoning from milk, ice-cream, cream-puffs, frozen custards, and cheeses is known. This poison seems to be due to the presence of a toxic substance which has been named by Vaughan of Ann Arbor, Mich., as tyrotoxicon.

As to poisoning from vegetable foods, the most important general poisons are those due to eating the poisonous mushrooms, and the grains affected by ergot and allied species. Thus ergotism as found in Russia, Spain, Italy, and its close ally pellagra are types of this form of food-poisoning. A well-known disease in eastern Japan and neighboring parts of Asia, termed beriberi (q.v.), is thought to be due to poisonous rice. See FUNGI; MUSHROOM; PTOMAINES; TOXICOLOGY.

Food Preservation is the method adopted for the preservation of organic substances used as food, either animal or vegetable, and may be considered under the following heads: (1) Preservation by cold; (2) Preservation by drying; (3) Preservation by salting; (4) Preservation by smoking; (5) Preservation by sterilization by heat and the exclusion of air; (6) Preservation by chemical or antiseptic substances.

1. *Cold.*— The application of cold for the preservation of meat and vegetables may now be conducted under modern methods of applying this agent, at temperatures varying from 0° F. (—18° C.) to 40° F. or more. In the large cold storage plants now established in many cities, in which ammonia is chiefly used for the production of variable degrees of cold, it is customary to provide several large chambers for the preservation of food in which different temperatures are required, fruit being kept at temperatures a little above the freezing point, and meats, fowl and especially fish at considerably lower temperatures.

In densely settled countries like England, where the land is insufficient to produce the necessary amount of meat for the food supply of the people, frozen meat from other countries forms a very large part of the food supply. If the meat is frozen before *rigor mortis* (rigidity following death) supervenes the meat keeps well, but if it is frozen later it rapidly decomposes after thawing. Freezing arrests putrefaction and has a tendency to conceal the odor of decomposition. Hence the bad condition of frozen fish may not be detected until the heat necessary for cooking is applied. Meat which has been frozen, is often unusually tender, on account of the loosening of the intermuscular tissue by freezing; bacteria can more readily penetrate into the interior of the thawed meat, and bring about rapid decomposition. Such meat and fish, especially when thawed too suddenly, lack the flavor of fresh meat. Bacteria in general and especially those which are concerned in the production of putrefaction, seem to be endowed with extraordinary powers of resistance to the action of cold. Colemann and Mickendrick kept flesh six hours in hermetically sealed boxes at temperatures from —6° to —130° C., but in every instance the flesh after being kept at a slightly warm temperature began to decompose in from 10 to 12 hours, though protected from subsequent infection. But cold, though it may not destroy micro-organisms, prevents their development, or at least does so in the case of putrefactive bacteria. There are, however, certain bacteria which are capable of developing in frozen meat, and especially in that which is kept at about 0° C. Lafar attributes to this cause, the unpleasant flavor sometimes acquired by meat which has been kept in a refrigerator for several days. This is confirmed by Popp, who says that the walls of such ice chambers when moist, swarm with bacteria, which in his opinion produce the

objectionable flavor often developed in stored meat.

The Detection of Frozen Meat.— Maljean describes a method of detecting frozen meat by microscopic examination of the blood of the meat. A drop of the blood is expressed from the meat upon a glass slide, covered with a thin glass, and examined as soon as possible to avoid solidification. The juice of fresh meat shows numerous red corpuscles of normal color and shape floating in a nearly colorless serum. But the corpuscles of frozen meat are more or less distorted in form and are completely decolorized, while the surrounding fluid is relatively dark in color. On placing a fragment of frozen meat in a test tube, containing some water, the liquid becomes colored more rapidly and intensely than when fresh meat is used.

2. *Drying.*— This is one of the oldest and best known of the various processes of preservation, and applies equally to animal and to vegetable products. By this means, beef and fish of many kinds, grapes, figs, apples, peaches, currants, and many other kinds of fruit are annually preserved by drying, and are thus rendered more suitable for transportation to distant markets, in consequence of great reduction in weight, as well as preservation from decay. The more rapidly the drying process is conducted the better. Drying is conducted in the open air by the aid of the sun's heat, or by artificial means. The curing of fish by drying constitutes an important industry in most northern maritime countries, the principal edible fish employed for this purpose being cod and herring, of which large numbers are dried in the fishing ports of the Atlantic coast north of Cape Cod, and in the British Islands and on the coast of Norway and Sweden. Fish are prepared for drying by the removal of the entrails, slitting them lengthwise, and then drying them in the open air.

3. *Salting.*—Salting is one of the oldest and best-known methods of preserving meat and fish. The most common method of preserving meat, especially pork, is by placing the meat in casks in layers, with salt between each layer. The salt withdraws water from the meat, and the brine thus formed penetrates the fibres of the meat. In Eckart's Munich quick-salting process, the meat is impregnated under pressure with a 25 per cent solution of common salt for 24 hours and then smoked. It is claimed that by this process the loss consists, mainly, of only water and a little phosphoric acid, that the meat has a better flavor, and that trichinæ are completely destroyed. As one of the results of salting meat is the removal of its natural color, it is quite customary to add a small quantity of saltpetre to counteract this effect. According to Lehmann, a small percentage only should be used on account of its harmful effect. Five grams of this salt have caused severe illness and eight grams have been known to cause death. The effect of the continued use of meat containing saltpetre, upon the human system, has not been determined by observation or by experiment.

Influence of Salting Upon Bacteria.— Forster's experiments show that the streptococci of erysipelas and many other well-known bacteria can live for weeks and even months in salted meat. The bacilli of tuberculosis retain their virulence for more than two months, and while the bacteria of anthrax perish in less than a day, their spores retain their vitality for a much longer period.

Effect of Salting Upon Flesh.— Salted meat is harder and more difficult of digestion than fresh meat. Voit shows by analysis that the nutritive value of meat is only slightly diminished after 14 days' salting. He found the percentage loss to be for water 10.4, organic matter 2.1, albumen 1.1, extractives 13.5, phosphoric acid 8.5. The amount of salt taken up by 1,000 grams of fresh meat was 43 grams. Polenske, on the contrary (Jahresbericht Nahr. u. Genussmittel 1891, p. 40), found that the meat, after being salted for three weeks lost 7.7 per cent of its nitrogenous constituents, and 34.7 per cent of its phosphoric acid, and after three months and six months the loss was still greater. He therefore concluded that the meat was greatly altered in its nutritive character, and that it could not be used continuously without injurious effects. Salted pork constituted a very important part of the food ration of the Union army in the Civil War, and when accompanied with an abundant supply of fresh vegetables, it was considered a wholesome article of food. Absence of the latter, however, was often the cause of serious illness. Strohmer gives the following analysis of fresh and salted herring:

	Fresh herring	Salt herring
Water	80.7	46.2
Nitrogenous substances	10.1	18.9
Fat	7.1	16.9
Ash	2.1	16.4
Salt	....	14.0

Caviare.— This is the salted roe of the sturgeon and other fish. It is prepared by washing the roe with salt water, leaving it in the brine for some time, pressing it, again treating it with salt water, passing it through a hair sieve, and finally packing it in salt. The most highly prized is the Astrakhan caviare, which is prepared at the mouth of the Volga. The following analyses of caviare are compiled from the works of Gobley and of König:

		Caviare	Pressed caviare
Water		43.89	30.89
Nitrogenous substances		30.79	40.33
Fat		15.66	18.90
N-free substances		1.67	....
Ash		8.09	9.88
The dry substance	N-substances	54.89	58.36
	Fat	24.02	27.35
	Nitrogen	8.78	9.36

4. *Smoking.*— The preservative qualities imparted to meat or fish by smoking are due partly to the drying action of heat, and partly to the antiseptic action of some of the substances of which smoke is composed, namely, creosote, formaldehyde, and pyroligneous acid. The smoke coagulates the albumen of the meat, and forms a protecting envelope. The best woods for the production of such smoke for preserving are beech, birch, and poplar, the conifers being unsuitable in consequence of the resin which they contain. There is no loss of nutriment, and Strohmer found that smoked meat is as digestible as fresh meat. Smoking may be con-

ducted in two ways: (1) by slowly smoking the meat for 24 hours at 25° C., or in the case of sausages and fish at 70° C., and then for a short time at 100° C.; (2) the meat may be placed directly in the hot smoke. Products prepared by the slow process have been found to contain more micro-organisms than those made more rapidly. The smoking should be continuous and not intermittent.

Action on Bacteria.— Serafini and Ungaro found that smoke acts energetically on pure cultures of bacteria, those of anthrax being killed in 2½ hours, and anthrax spores in 18 hours. Bacilli in the interior of the meat were not killed. Forster found the bacilli of tuberculosis still virulent in the interior of meat after it had been salted and smoked.

The following analyses of smoked and salted meats and fish are from the works of Strohmer and König:

	Water	Nitrogenous substances	Fat	Ash	Common Salt
Ham	59.73	25.08	8.11	7.08	....
Smoked beef...	47.68	27.10	15.35	10.59	....
Smoked herring	64.49	21.12	8.51	1.24	....
American bacon	9.15	9.72	75.75	5.38	....
Mackerel	44.45	19.17	22.43	13.82	11.42
Salmon	51.46	24.19	11.86	12.04	10.87

During the process of salting and smoking the coloring matter of meat is changed, as shown by the spectroscope. Smoked ham and other meats have an alkaline reaction.

5. *Preservation by Exclusion of Air After Sterilization by Heat.*— In early times food was preserved to a limited extent by heating in earthen vessels, and sealing hermetically by such crude processes as were available. At the present day such methods have given place to preservation, either in tin cans or boxes or in glass. In the former instance food may be preserved for long periods, by means of soldering, and in the latter by means of tight-fitting joints and rubber rings. The latter method is not so much used in trade, but is largely employed for domestic purposes. The prudent housewife also makes use of surface layers of paraffine and waxed paper for the temporary exclusion of air. Tin cans are stronger, and more tight, and more economical. Almost every kind of perishable food is now preserved in this manner.

In the United States the preservation of meats, poultry, fish, vegetables, and fruits in this manner has become an important industry and branch of commerce, both domestic and international. The canning of meats is conducted to a great extent in those cities where great slaughtering establishments are located. The canning of vegetables and fruits is carried on at places located among the great fruit-producing regions, while the fish canneries are mostly upon the rivers and in the seacoast towns of the northeast and northwest States and Provinces where the fish are taken from the water. The cans filled with their contents are either heated in steam retorts or immersed in boiling water. A small hole is left in the cover, and while still hot, the hole is closed with a bit of solder. In a few days the cans are tested by tapping them with a wooden mallet or hammer. If the cap sinks slowly, the can has been properly sealed, but if it is elastic, and springs back, it is rejected as a "swell-head." In the preservation of corned beef, the cans are pierced to allow the water and fat to escape, and are then soldered and placed in boiling water again for several hours.

Canned roast beef is largely used as a part of the army and navy ration, especially during the time of war, and upon the frontier. The method of preparation is thus described by Munson: "The beef is first placed in water and maintained at a temperature of 95° C. until well cooked. It is then removed, trimmed and placed in cans, a little gelatine being added to bind the meat together. The cans are then sealed and either submerged in boiling brine, or placed in superheated steam at 125° C. The steam in the can escapes through a puncture made in the top of the can which is immediately afterward closed with solder. The meat being sealed while hot, any portion of enclosed space is a partial vacuum; consequently a good can of meat will usually present a concave appearance on the outside, from atmospheric pressure.

When a can is bulged it is bad — unless frozen — and should be rejected. Freezing causes a bulging of the ends of the cans without injury to their contents. The ends, after the contents are thawed, return to their former shape, unless this process has been several times repeated.

The process of canning involves the making and soldering of two punctured holes in the top of each can. The presence of three such holes is evidence that the can had been imperfectly treated, and that it was reheated, the gas allowed to escape and the hole punctured for this purpose again sealed. The contents of such reheated cans are more likely to be of inferior quality than those of properly prepared cans. On this account the packers are careful to make the third puncture as inconspicuous as possible, and often to conceal it entirely by making it on the side of the can near the top and pasting the label over it. This may usually be detected by running the finger around the rim of the can.

Sometimes newly packed cans are so much swollen that reheating is not sufficient. In such cases the cans are opened, the contents sorted and the sound parts repacked in cans as before. The quality of such articles can only be determined by opening the cans and examining their contents, which present an overcooked appearance. First-class canned goods have the name of the manufacturer and often that of the wholesale house through which they are sold upon the labels, while doubtful goods have a fictitious factory name and no dealer's name.

Canned peas are subject to great variations in quality. Dried peas are bought in large quantities, soaked, heated and canned. Such articles can usually be recognized by their appearance and taste on opening the cans. To such an extent is this done as to have led to legislation in some States requiring all such cans to be legibly marked "soaked."

French canned peas and beans are often colored with sulphate of copper, which improves their appearance, but not their taste. The sale of such articles is forbidden in some countries.

The Composition of Canned Meats.— König found the following results in samples of canned meats and salmon. From 48 to 65 per cent of water, from 15 to 33.8 per cent of nitrogenous

substances, from 0.2 to 21.6 per cent of fat, and from 2.3 to 21 per cent of ash. Of the water-free substances, there were from 43 to 78 per cent of nitrogenous substances, and from 0.3 to 43 of fat. The albuminous substances were generally less than those of fresh meat, the actual figures varying in different kinds of meat, from 87.06 to 93.94 per cent as much as that of fresh meat. The preservation of food by hermetic sealing in cans has, within the last half century grown to be an important factor in the commercial and industrial development of the United States. Before 1795 drying and the use of salt and sugar were the only methods used to any considerable extent in the preservation of food. Nicholas Appert, a Frenchman, stimulated by the offer of a reward for a mode of preserving food for use at sea in the navy, submitted to his government a treatise upon the hermetic sealing of all kinds of food. His principle, as set forth in this work, was practically the same as that which is now in use, the exclusion of air, and the application of heat for the purpose of sterilization. France first purchased his process and the industry soon spread to England and Ireland.

One of the first persons who introduced the industry into the United States was Ezra Daggett, who arrived in New York between 1815 and 1818. In 1819 he was engaged in the manufacture of hermetically sealed goods, chiefly salmon, oysters, and lobsters. William Underwood arrived at New Orleans from London in 1817, having learned the trade of pickling and preserving with the house of Mackey & Company. Not liking the climate of the South he walked from New Orleans to Boston, where he and Charles Mitchell introduced the same industry, applying it to pickles, sauces, jams, and fruit. Glass jars were at first used, but on account of their expense and fragile nature, they were soon largely supplanted by tin cans, which were introduced in 1825 by Thomas Kensett. The making of tin cans for this purpose became an important industry, various improvements being made from time to time in the processes of manufacture.

During the Civil War large quantities of canned meats, tomatoes and other vegetables and fruits were furnished both to the army and to the navy, and during the Spanish war the use of preserved meats treated with chemical antiseptics at one time threatened to become a lively campaign issue.

According to the census of 1900 there were in that year 2,195 establishments for the canning and preserving of fruits and vegetables, fish and oysters in the United States, having an aggregate capital of $48,497,978. The value of their products was $82,592,196. The number of wage-earners averaged 52,581, and $12,910,399 were paid for wages. Of the total capital, $27,743,067 was devoted to the canning of fruits and vegetables, $19,514,215 to fish, and $1,240,696 to oysters. The exports of canned or preserved fish, fruits, and vegetables in 1900 exceeded the imports by about $2,500,000.

The capital devoted to the canning of fruits and vegetables had increased from $2,335,925, in 1870, to $27,743,067 in 1900, and the number of establishments from 97 to 1,808.

The number of establishments in the New England States in 1900 was 80, in the Middle States 945, in the Southern States 204, Central 380, Western 28, Pacific 171. The largest numbers in single States were in New York 511, Maryland 271, California 136, Michigan 98, Virginia 88, New Jersey 73, Ohio 70, Illinois 61, Indiana 60, Maine 59, and Delaware 51. The value of the products was, in California $13,081,829, in Maryland $11,996,245, in New York $8,975,321 and in Illinois $3,730,030. The principal preserved fruits and vegetables in value were tomatoes $13,926,749 (641,219,993 pounds), corn $8,230,975, peas $4,679,426, beans $2,124,208, peaches $4,414,277, pears $2,233,166, apples $1,160,728, apricots $1,591,567, dried apples $1,913,142, dried prunes $970,927, and raisins $720,268.

The drying of fruit is confined chiefly to California and New York, these States reporting 87.2 per cent of the total number of pounds. Maryland leads in oyster canning and is among the first in the canning of tomatoes, corn, peaches, peas, lima beans, pears and pineapples. Maine is the leading State in sardine canning, and New York leads in canning corn, apples and pears.

Fish Canning and Preserving.— The number of establishments devoted to fish canning and preserving in the United States in 1900 was 348, having increased from 110 in 1890. Of the total number in 1900, 117 were in Maine, 61 in Massachusetts, 36 in Alaska, 36 in Washington, 24 in Oregon, and 19 in California. The value of products in 1900 was $22,253,749, of which Maine produced $4,779,733, Washington $4,831,038, Alaska $3,821,136 (or more than half the amount paid Russia for this territory), and Oregon $1,788,809.

By far the greatest capital employed in any single city in fish preservation was in Gloucester ($1,479,647), and secondly in Seattle, Wash., $336,620.

The canning of fish was introduced at Eastport, Maine, in 1843, lobsters and mackerel being preserved in this manner. Establishments for salmon canning were started on the Columbia River in 1866, and at Klawak, Old Sitka and Cook Inlet in Alaska in 1878 and 1882. The labor in these salmon canneries is chiefly performed by Chinese. The sardine canning of Maine is next in importance to the salmon canning of the Pacific coast. Sardine is a general term applied to various small fishes, the best known being the young of the pilchard (French) and the young of the sea-herring (coast of Maine). The fish are first fried in oil, and then placed in a can with oil. Olive oil or peanut oil are chiefly used in France for this purpose, and cotton-seed oil in Maine.

The number of establishments engaged in oyster canning in the United States in 1900 was 39, of which 16 were in Maryland, 6 in Florida, and 4 in Mississippi; $1,240,696 in capital was devoted to this industry, and the products were valued at $3,670,134, of which two thirds were produced in Maryland. In canning oysters in large quantities, steam is employed, the oysters being put into a steam-tight box and submitted to the action of steam for 15 minutes, by which process they are more readily opened and made ready for canning.

The extent and importance of the food canning industry of the United States may be estimated by the fact that 400,000 persons are employed in the work of canning, manufacture of cans, packing boxes, etc. It would require 60,000

freight cars to transport a year's product; 750,000,000 cans, 2,000,000 boxes of tin plate for the cans, and 30,000,000 wooden packing boxes.

6. *Preservation by Chemical Substances.*—For many years it has been the custom to employ salt, sugar, alcohol, and saltpetre for the purpose of preserving meat and fish, and some of these substances for the preservation of fruits and vegetables, and no objection has been made to this practice; but in more recent times, and since preserved food has come into more general use, the practice of using other substances has also largely increased. The question whether the use of such articles for this purpose may be injurious to the health of the consumer does not appear to have been yet satisfactorily settled. The experiments of Tunnicliffe and Rosenheim would appear to show that food mixed with boric acid and borax, taken separately and together in such quantities as are ordinarily employed, may be eaten with impunity, but earlier observers have arrived at contrary conclusions. On account, therefore, of the possibility of the use of such chemicals in the preservation of food by persons wholly unacquainted with their physiological properties, legislation appears to be tending in the direction either of prohibition of the use of chemical preservatives or of regulating their use by making their presence known to the consumer. Many substances have been experimented upon with reference to their preservative quality, among which are sulphur dioxide, sulphites and bisulphites, boric acid and its compounds, fluorides, chlorides, alum, lime, sodium carbonate, formaldehyde, benzoic and salicylic acid and their compounds. At the present time boric acid, salicylic acid, and formaldehyde appear to be most frequently used.

Boric acid is most often used for the preservation of meats, certain kinds of fruits and catsup, and upon hams and fish. The latter are found to keep longer if the boric acid is rubbed over the outside. Two grams per kilo is sufficient for fish. According to le Féré boric acid is eliminated slowly from the system, having been detected in the urine 40 to 50 days after it had been taken. It does not appear to interfere seriously with digestion so far as could be concluded from experiments. Cases of flesh poisoning have been reported from Switzerland, where meat had been preserved with borates, which had not acted sufficiently as preservatives, but had only masked incipient putrefaction.

Sulphur and its compounds have been used to some extent for the preservation of food, but not so much at present as formerly. These compounds and especially sulphur dioxide have a powerful germicide action. Authorities differ as to their physiological action. Polli found that 8 to 12 grams of sulphite were not injurious to adults. Ostertag, Bernatzik, and Braun found that one gram of magnesium sulphite caused disorders of the stomach in women. Fischer found that 50 per cent of the preserved meat products sold in Breslau in 1895 contained sulphites, the quantity of sulphur dioxide varying from .34 to .01 per cent. According to Riche, sulphurous acid and its salts, especially calcium bisulphite, have a considerable action on meat, altering its normal condition. This action causes changes in the soluble proteid substances. An addition of 1 per cent of a sulphite to meat is not perceptible to taste or to smell. On cooking the meat the sulphite is only partially decomposed and expelled. Fischer states that meat containing more than 0.1 per cent of sulphur dioxide should be regarded as injurious to health.

Salicylic acid is one of the constituents of many of the modern meat preservatives. Bersch placed a portion of the flesh of a recently slaughtered animal in a concentrated aqueous solution of salicylic acid, and found that after four days the exterior of the meat was perfectly sound, but the interior showed signs of putrefaction, and contained many micro-organisms. He therefore concluded that the preservation of fresh raw meat by salicylic acid was not practicable. In such meat compounds as sausages and potted meat, where the salicylic acid is uniformly distributed through the mass, its germicidal properties would obviously exert a more decided action. On account of its decided taste it cannot be used so freely in meat preparations as in other kinds of food in which the taste of the preservative is concealed. Here again authorities differ as to the action of this preservative on the human economy, when used in connection with food substances. The Paris Academy has forbidden even the least addition of salicylates to food, on account of their liability to injure the kidneys or digestive organs, when any weakness of these organs exists.

Formaldehyde.— In recent years formaldehyde has been introduced as a preservative in consequence of its powerful antiseptic action. A proprietary preservative known as "Carnolin" consists of a 1.5 per cent solution of formaldehyde slightly acidified. It exerts a decided antiseptic action on milk in very small amounts. The effect of salicylic acid upon the system, when employed in the small proportions required for food preservation has not yet been well determined, but its power of forming insoluble compounds with proteid substances, and its hardening power upon animal tissues, would seem to render meat treated with it much less digestible than otherwise. Mahery and Goldsmith found that formaldehyde in the proportion of 0.2 gram limited the artificial peptic digestion of blood fibrin. Ludwig states that formalin is not applicable to the preservation of meat products. Ehrlich tried the effect of an 8 per cent. solution of formaldehyde on various food substances. He found that horseflesh was completely preserved by it, but that the odor developed was such that the meat could not be eaten. Beef thus treated did not develop this odor, but was only fit to be eaten for a short time after addition of the preservative, on account of the chemical changes which it produced. According to Bloxam formaldehyde causes fish to become so hard as to be unsalable even if the solution contains only one part in 5,000.

British Investigation Relative to the Use of Preservatives.— A committee was appointed in 1899 to report to Parliament upon the "Use of preservatives and coloring matters in food," the object of the investigation being to ascertain:

1. Whether the use of such materials, or any of them, for the preservation and coloring of food, in certain quantities, is injurious to health, and if so, in what proportions does their use become injurious?

2. To what extent and in what amounts are they used at the present time?

This committee held many hearings and examined 78 witnesses, among whom were the principal experts in England, physicians, health officers, chemists, grocers, dairymen, and representatives of different food interests.

The committee reported that the preservatives found in use other than alcohol, oils, vinegar, salt and sugar, were boric acid and other boron preservatives, sulphurous acid and sulphites, fluorides, salicylic acid, benzoic acid, and formalin or formaldehyde. A list of 4,251 articles of food examined at the government laboratory for preservatives was presented, of which 1,659, or 39 per cent, were found to contain preservatives. These consisted of 35 different kinds of food and beverages. The articles in which the greatest ratio of preservatives was found were lime and lemon juice, 88.5 per cent, ham 82.7 per cent, cream 77.9 per cent, margarine 74.4, pork-pies 70.8, cordials 70.8, bacon 70.5, sausages 66.4, fruit syrup 65.2, butter 57.1.

Of the 1,659 samples treated with preservatives, 1,249 contained boron compounds, 320 salicylic acid, 20 formalin and 143 sulphites.

The committee were of the opinion that preservatives should not be used in milk, since the milk producer might be liable by such use to protect himself against the immediate results of scrupulous cleanliness. Under the influence of preservatives milk may be exposed without sensible injury to conditions which would otherwise render it unsalable. It may remain sweet to the taste and smell, and yet may contain disease germs of various kinds, whereof the activity may be suspended for a time by the action of the preservative, but may be resumed before the milk is digested.

The following were the general conclusions of the committee, so far as preservatives are concerned:

a. That the use of formaldehyde or formalin or preparations thereof, in food and drink be absolutely prohibited, and that salicylic acid be not used in a greater proportion than one grain per pint of liquid food, and one grain per pound of solid food; its presence in all cases to be declared.

b. That the use of any preservative or coloring matter whatever in milk offered for sale in the United Kingdom be constituted an offense under the food and drug acts.

c. That the only preservative which it shall be lawful to use in cream be boric acid or mixtures of boric acid and borax, and in amount not exceeding 0.25 per cent expressed as boric acid, the amount of such preservative to be notified by a label upon the vessel.

d. That the only preservative permitted to be used in butter and margarine, be boric acid, or mixtures of boric acid and borax, to be used in proportions not exceeding 0.5 per cent expressed as boric acid.

e. That in the case of all dietetic preparations, intended for the use of invalids or infants, chemical preservatives of all kinds be prohibited.

The following statement appears in the 33d annual report of the State Board of Health of Massachusetts (1901). Out of 7,323 samples of milk examined with special reference to the presence of preservatives, 184, or 2.5 per cent, contained formaldehyde; 42, or .6 per cent, contained boric acid, and 7 contained carbonates. These samples were all obtained in the summer months.

Legislation Relative to the Use of Preservatives.— At present Austria has no law upon this subject. In Belgium the use of preservatives in milk is forbidden. In Denmark a law of 1897 prohibits the use of all preservatives except salt in butter and margarine. The use of several specified preservatives in wine is also forbidden. In France the sale of food containing either salicylic acid or formalin is prohibited. In Germany, by a law of 1879, spoiled goods sold in a state concealing their real condition make the vendor liable to a penalty. The addition of alum, boric acid and salicylic acid to wine is also forbidden. The following conclusions have been reached by the Imperial Health Board of Germany regarding the use of sulphurous acid in mince meat:

1. From fresh butcher meat without chemical preservatives, but with due observance of cleanliness, mince meat can be produced, which, if kept at a low temperature, will retain its natural color for more than 12 hours.

2. The addition of preservatives which contain sulphurous acids and similar salts can improve the natural color of the meat, but not the meat itself. By their means mince meat can appear to be of better quality than it really is.

3. The frequent consumption of mince meat which is treated with sulphurous acid salts may be injurious, particularly to people of delicate health.

The Imperial Health Board is also carrying on a series of experiments relative to boric acid and its compounds.

There is no law in Norway prohibiting the use of preservatives in food, unless they can be shown to be injurious to health. In Switzerland each canton acts for itself and there is no general law upon the subject.

Legislation in the United States.— At present there is no law of the general government upon the subject. In the report of the secretary of agriculture in 1899 were the following suggestions:

"It is not regarded as a wise thing to absolutely prohibit the use of preservatives in food. Since, however, all chemicals which have the property of preserving food have also a tendency to interfere with the process of digestion, it is held to be imperative that no food should be offered for sale which contains a preservative without having this fact plainly stated upon the label of the package. Not only should the label state that the food product contains a preservative, but it should also give the name of the preservative, and the quantity employed. In this way the intending purchaser is fully informed in regard to the character of the product which he buys. While it has been established that a healthy stomach can from time to time receive with impunity food containing small quantities of preservatives, it is by no means certain that the continued practice of ingesting preservatives in foods would not produce serious injury. On the other hand, it is also quite certain that weak or diseased stomachs may suffer temporary or permanent injury from minute quantities of preservatives. See Adulteration.

In the different States of the Union there is very little uniformity in the legislation relative

to the use of preservatives in food, many States having no laws whatever upon the subject.

In Minnesota by a law of 1899 the sale of milk, cream or food products of any nature whatever "to which has been added any preparation in powdered or liquid form, known as preservatives, except salt in butter" is forbidden. In Nebraska the sale of cider containing preservatives is forbidden. In New York the use of certain preservatives in wine is forbidden. In North Carolina the name of any preservative "must be made clearly known by conspicuous labeling, or made known to the purchaser when the article is not capable of being labeled." In Ohio the use of salicylic acid or any other antiseptic in wine is forbidden. In Oregon the use of preservatives in butter is forbidden. In Pennsylvania refrigeration is the only allowable mode of preservation for fresh meats. Canned meats, pickled and salted meats and meat extracts must contain no other preservatives than salt, sugar, spices, vinegar, smoke, or saltpetre. In South Dakota no preservatives are allowed in jellies or meats. In Utah they are forbidden in milk. In Washington certain drinks as well as cream and milk must not contain salicylic, benzoic, or boric acid. In Wisconsin, the use of any preservative is forbidden in milk, cream and catsup. See ADULTERATION; FISH AS FOOD; FOOD; MEAT; MILK; REFRIGERATION, etc.

Bibliography.— Abel, 'Zum Kampfe gegen die Konservirung von Nahrungsmitteln durch Antiseptica' (1901); Archiv für animalische Nahrungsmittelkunde (1888–1903); Bigelow, 'Canned Meats' (U. S. Dept. of Agriculture, 1902); Douglas' Encyclopedia; 'A Book of Reference for Bacon Curers, Meat Purveyors, etc.' (1901); Gerlach, 'Handbuch der Fleischkunde'; Harrington, 'A Manual of Practical Hygiene' (1901); König, 'Chemie der menschlichen Nahrungs- und Genussmittel,' second edition (1893); Mitchell, 'Flesh Foods, their Chemical, Microscopical, and Bacteriological Examination' (1900); Munson, 'The Theory and Practice of Military Hygiene' (1901); Ostertag, 'Handbuch der Fleischbeschau'; Strohmer, 'Die Ernahrung des Menschen' (1887); United States Census, 'Fruits and vegetables, fish and oysters, canning and preserving,' Bulletin No. 209, 25 June 1902.

SAMUEL W. ABBOTT,
Massachusetts State Board of Health.

Foods for the Sick. See SICK, FOODS FOR.

Fool. See JESTER.

Fool of Quality, The, a curious novel by Henry Brooke, published originally in five volumes (1760–77). It was considered of such spiritual value by John Wesley, the founder of Methodism, that he prepared a special edition of it for the use of his followers. Toward the close of the book its mysticism becomes exceedingly exalted and visionary, suggesting the author's acquaintance with the teachings of the German mystic, Jacob Boehme. The work as a whole is hardly capable of holding a modern reader's interest. It had, however, no mean place in the popular fiction of the 18th century.

Fool's Cicely. See DOG PARSLEY.

Fool's Errand, A, a story by Albion W. Tourgee, published in 1879. It is the first of a series dealing mainly with events connected with the Civil War. "The Fool" is Comfort Servosse, a Union colonel, who removes from Michigan to a southern plantation after peace is declared. The story of his reception there and the difficulties encountered, arising out of old prejudices upon the one hand and his own training and convictions upon the other, is told with much detail and strong local coloring.

Fools, Feast of. Festivals, under this name were regularly celebrated, from the 5th to the 16th century, in several countries of Europe, by the clergy and laity, with the most absurd ceremonies, and form one of the strangest phenomena in the history of mankind. Among the heathen festivals which the Christians could not easily abolish, were the Saturnalia, which, in the confusion of all distinctions of ranks, and in extravagance of merriment, exceeded the gayest carnivals. The feast of fools, among Christians, was an imitation of the Saturnalia, and, like this, was celebrated in December. The chief celebration fell upon the day of the Innocents, or upon New Year's Day; but the feast continued from Christmas to the last Sunday of Epiphany. At first only the boys of the choir and young sacristans played the principal part in them; but afterward all the inferior servants of the Church, and even laymen, engaged in them, while the bishop, or the highest clergyman of the place, with the canons, formed the audience. The young people, who played the chief parts, chose from among their own number a bishop or archbishop of fools, or of unreason, as he was called, and consecrated him, with many ridiculous ceremonies, in the chief church of the place. This officer then took the usual seat of the bishop, and caused high mass to be said, unless he preferred to read it himself, and to give his blessing to the people, which was done with the most ridiculous ceremonies. During this time the rest of the performers, dressed in different kinds of masks and disguises, engaged in indecent songs and dances, and practised all possible follies in the church. Except from their association with the Saturnalia nothing is known of the origin of these extravagancies, which appear to have been very ancient. The most celebrated, and probably one of the most ancient of these festivals, was held in the city of Sens, in France. By an ordinance in 1245, intended to abolish it, it is alluded to as a very ancient celebration. So general was the custom of these celebrations in France, that it is said there were few towns at the end of the 17th or even as late as the middle of the 18th century, in which associations did not exist. Similar antics seem to have been played in other countries, as Germany, England, and Scotland, but it is to be hoped that the height of profanity reached in some of the extant liturgies and rubrics was not commonly attained in these fooleries. The *fête des fous* at Sens was suppressed in 1547. These fêtes were frequently prohibited, but until the Reformation period, when they were considered dangerous by the ecclesiastical authorities, they were commonly tolerated. To account for these celebrations, so opposed to all our ideas of religion, decency, and common sense, we must transfer ourselves to times when men combined, with childish simplicity, the most ridiculous with the noblest subjects, and often with less injury than we should suppose to the latter. Similarly, grotesque or indecent figures are to be seen among the sculptures of old Gothic churches, and may not unfrequently be detected in the work of the large

initial letters of the breviaries and religious books of this period.

Fool's Parsley. See Dog Parsley.

Foot, Solomon, American statesman: b. Cornwall, Vt., 19 Nov. 1802; d. 1866. He was graduated at Middlebury College in 1826 and in 1831 was admitted to the bar, and settled in Rutland. For several terms he represented the town of Rutland in the Vermont legislature, and in 1842 and again in 1844 was elected a representative in Congress. From 1851 till his death he sat in the United States Senate where he made many important speeches, and bore a conspicuous part in the Lecompton debate of 1858.

Foot. In the human foot the bony structure is made up of three divisions, the tarsus, metatarsus, and phalanges. Seven bones form the tarsus; the os calcis or heel-bone, the largest and strongest of all, carries the principal part of the body's weight. On its posterior surface the large muscles of the calf find their attachment through the tendon Achillis. Half in front of the os calcis and superimposed upon it is the next largest bone, the astragalus. This bone bears directly the weight of the body through the large leg-bone, the tibia, resting on the upper surface. On the outer side in front of these two bones is the cuboid, and on the inner side the scaphoid or navicular bone. In front of the scaphoid there are the three small cuneiform bones, internal, middle, and external. These three bones with the cuboid form articulations with the next row or division. The metatarsus is formed of five so-called long bones; that is, each bone has a shaft and articulating extremities. To each of these is joined one of the next division or phalanges. These are also long bones, the great toe made up of two bones, and the others of three each. Strong ligaments bind these bones to one another in such a way as to form and maintain an arch from before backward, and somewhat from side to side, the points of contact with the ground being only with the os calcis behind and the metatarsus and phalanges in front — the so-called ball of the foot. By this arrangement shock is transmitted through an arch or spring, pads at these two points also further eliminating jars. The sole of the foot is also covered with small muscles, which move the toes, and tendons that flex the toes and extend the foot on the ankle. Across the dorsum or instep pass the flattened tendons that flex the foot and extend the toes. The chief artery to the sole comes down on the inner side of the heel, passing across to the outer side, then arching across to the inner side again, giving off branches to the toes. On the dorsum the main artery comes to the surface at the instep and forms an arch of supply to the toes. The nerves on both surfaces closely follow the arteries.

Among the lower animals, monkeys have feet that approach nearest to those of the human. The separation of the great toe, in a way corresponding to the thumb, and the absence of the arch are the points of difference. In many of the animals, as in the cat tribe, there is a greater or less tendency toward a rudimentary inner toe, and an increase of the function of the ball of the foot, with a lessening of the importance of the heel. In the cattle and equines the toes are fewer, and the nails or claws become converted into hoofs. The horse walks on the end of his single digit.

In measure of length, the name foot is derived from the length of the human foot, containing 12 linear inches. Square foot is a square whose side is one foot, and is therefore equal to 144 square inches. Cubic foot is a cube whose side is 1 foot, and the cube contains 1,728 cubic inches. The foot is a common measure in various countries, but its dimensions often vary somewhat. In poetry, a measure consisting of a variety of syllables, two, three, or four, in combinations of long and short, or accented and unaccented syllables. The number of possible varieties of feet is reckoned at 28. See Rhythm.

Foot and Mouth Disease. See Murrain.

Foot-pound, the unit of work or of energy that is commonly used in engineering calculations in England and the United States. It is defined as the quantity of work expended in raising a weight of one pound through a vertical distance of one foot. As the attraction of the earth for a pound of matter varies somewhat in different latitudes and at different heights above the sea, the foot-pound is subject to corresponding variations as we pass from one locality to another. To give the unit greater definiteness it has been proposed to define it as the quantity of work done in raising one pound of matter through a vertical distance of one foot, at the level of the sea in latitude 45°. This definition differs from the ordinary one, it will be observed, solely by specifying the locality at which the experiment is supposed to be performed. See Units.

Foot-rot, a disease in the feet of sheep, the more common form of which is an inordinate growth of hoof, which at the toe, or round the margin, becomes turned down, cracked, or torn, thus affording lodgment for sand and dirt. In the second form of the disease the foot becomes hot, tender, and swollen, with ulcerations between the toes, followed by the sprouting of proud flesh. The inflammation is due to suppression of the secretion of the gland between the toes, usually the result of standing too much in wet ground. The best remedy is to pare away the diseased and ragged parts of the hoof, thoroughly applying a lotion made by dissolving one pound of blue vitriol in a quart of water, and keeping the animal always in a dry place.

Foot-wall. In mining language, the foot-wall of a vein is the rock boundary of its lower side, the side on which a miner would stand in breaking down the ore. The term is also used in speaking of a fault or rock dislocation, the foot-wall of a fault being formed by the edges of the rock strata that underlie the plane of displacement. See Fault; Mining; Ore Deposit.

Foota-Jallon. See Futa-Jallon.

Football in America, as in England, is of different varieties, but by far the most prominent is the game played in the colleges. This type is the outgrowth of the English Rugby and still possesses points of similarity to the game from which it was derived. Association football is played in and around some of the mill towns where the foreign population predominates, and previous to 1870 a mongrel kind of football made up of a combination of Association and Rugby had some vogue, and was the original form of the sport in America.

The type, however, known as American football suggests now only one variety and that is the one mentioned above as prevailing in colleges and universities. This sport draws to each of its chief annual contests from 25,000 to 40,000 spectators. During its season, which consists of October and November, it temporarily eclipses all other athletics in interest. For this reason it is the money maker in college athletics, in a great number of universities the receipts from the football contests practically supporting the other athletic branches throughout the year.

This sport, developed as it now stands, was originally introduced into American colleges by Harvard, whose team, having visited Canada and played under the Canadian rules, became enamored of the style of the English Rugby, and, although in 1875, as a matter of consideration for her ancient rival, Yale, Harvard agreed to compromise between what was then known as American football and English Rugby, in the next year, 1876, both teams adopted the Rugby Union rules as they stood at that day. Unfortunately for the peace of mind of the legislators, but probably fortunately in another way, in that the final result was the development of still another distinct type of football, there were no traditions in America regarding the English Rugby code and what was forbidden by letter was accepted as barred, whereas anything that was not thus distinctly prohibited the American player thought was perfectly legitimate. Contentions arose over the interpretation of the rules and these discussions led to conventions, and, in the settlement of the problems arising, the rules rapidly multiplied, until in a few years there were more than twice the original number. While this was happening, some of the old English rules apparently became dead letters and were, therefore, dropped. When captains and players attended any of these conventions it was only human that they should contend for possible advantages for their own teams rather than for the improvement of the game as a sport and this led to the appointment of an advisory committee of graduates. In their hands was placed the matter of rules to this extent, that yearly they met and recommended changes which were then submitted to an intercollegiate association for discussion and usually for approval. This lasted as long as there was an intercollegiate association or league of colleges indulging in football. This league finally dissolved and for the season following there were two codes of rules in existence adopted by two different sets of universities. This was wholly unsatisfactory and led to the intervention of the University Athletic Club of New York. This club selected football enthusiasts and asked from them a recommendation as to a code of rules. These gentlemen met and framed such a code, which was then adopted by the various colleges throughout the country. This method of procedure lasted for several years, even after the dissolution of the University Athletic Club, and it is from this body that the football rules still emanate.

This describes the entire legislative machinery, and shows how carefully the game has been watched over and gives some idea of the reasons for its steady and consistent growth in popularity.

As for a brief description of the game and the way in which it is played, the following gives the main points:

The game is played on a field rectangular in shape, 160 feet wide and 330 feet long. The outline of this field is made by heavy white lines marked, as are the lines in a tennis court, with lime. This field is also traversed by transverse lines five yards apart marked for the convenience of the referee in judging the distance gained or lost by either side. In addition to these transverse lines under the rules of 1903 the middle section of the field, that is the space from one 25-yard line to the other, is marked by longitudinal lines also five yards apart in order to assist the referee once more in measuring distance rapidly with his eye. This latter marking was rendered necessary by a rule providing that within that section of the field the quarter-back may run with the ball provided he goes a certain distance out, that is, toward the side line, from the man who puts the ball in play in the centre. The lines which mark the ends of the field are called goal lines, and in the middle of each is a goal made by erecting two posts 18 feet, 6 inches apart with a cross bar 10 feet from the ground. The ball is a prolate spheroid in shape consisting of a rubber bladder encased in a leather cover.

The game is played by 11 men on a side, these 11 men being called a team. For the purpose of general distinction, although different formations are possible, the seven men who play in the forward line, that is on a line with the ball when it is put in play, are called the rushers, the men behind them the backs. The distinguishing terms for the men in the line are of interest. First there is the centre rusher, or centre, or snap-back, which term designates the man who stands in the middle of the line and usually puts the ball in play in a scrimmage. The men on his right and left are called guards, the men next beyond them toward the ends are called tackles and the two men on the ends of the line are called the ends. The man close behind the centre rusher is called the quarter-back. The two men some feet behind him are called the half-backs and the fourth man behind the line is called the full-back. In executing various plays the men take up different positions on the field, but they are usually distinguished by their positions as above, which they assume when the play is between the two 25-yard lines, and the ball is on the ground for a scrimmage.

The game is started by placing the ball in the middle of the field and a man of the side in possession must then kick it at least 10 yards into the territory of the opponents, his own men being behind him when he kicks the ball and the opponents standing at least 10 yards back from the middle line of the field. The choice of goals and the possession of the ball having been determined by the toss of a coin, the side winning has the privilege of thus either kicking off or selecting either goal. When the ball is once kicked off any man who is on side, that is, between the ball and his own goal, may secure it and run with it and when he is thus running may be tackled by his opponents and brought to a stop. If he is thus tackled and stopped he calls "down" and the ball is placed on that spot for a scrimmage. When the ball is thus down the two teams line up opposite each other, the side with the ball en-

deavoring to protect its men so that one of the backs may be able to secure the ball and make a run with it, while members of the opposing side are endeavoring to break through and stop this. The men of the side which has the ball in its possession may not use their hands or arms to obstruct their opponents, but may do this with the body only. The players of the side not in possession of the ball on the other hand are privileged to use their hands and arms to break through the ranks of their opponents. The man who has the ball in his possession, that is running with it, may use his hands and arms to ward off the opponents, but the rest of his side may not. The play thus continues by a succession of downs and runs interspersed with kicks, for a side may kick the ball instead of running with it if they so desire.

In order to prevent a side holding the ball indefinitely without making progress there is a rule providing that in 3 attempts the side must advance the ball 10 yards or take it back 20 or surrender it to the opponents. For this reason it is quite customary after two attempts, if the desired ground has not been gained, for the side in possession to kick the ball, thus transferring it to the possession of their opponents as far into the opponent's territory as possible. When the ball goes across the side line it is out of bounds and if it has gone out of bounds through being kicked, it belongs to the opponents, but if a man carries it out of bounds, in his possession, his own side has the right to it. The ball is brought back to the spot where it crossed the line and is put in play either by bounding it into the field of play, or, far more usually, by the holder walking in a certain distance and putting it on the ground for a scrimmage as already described.

The game thus proceeds until the ball approaches one or the other goal line and here begins the question of generalship for scoring. If the ball be kicked by a drop kick over the cross bar of the opponent's goal it counts the side thus kicking it five points. If the ball be carried by the player of that side across his opponent's goal line or secured by him after it has been kicked across it scores a touch-down, which counts four points and also entitles the side making it to a try at goal. This is performed either by kicking the ball out to a player who catches it and makes a mark with his heel, the ball then being kicked from any point behind that mark, or being brought directly out by a player of the side which has touched it down and held on the ground for another of his side to kick. In either event if the touch-down be converted into a goal by the kicking of the ball over the cross bar it adds an additional point for this scoring.

There is one other possible means of scoring and that is when a side is pressed by the opponents, and, instead of the opponents securing the ball, the defenders of the side secure it and either kick, pass, or carry it across their own goal-line and touch it back behind their own goal it entitles them to carry the ball out 25 yards for a kick. The opponents stand on the 25-yard line while this kick is made. This safety, however, as it is called, counts two points against the side making it.

The game is divided into 2 halves of 35 minutes each with a 10-minute intermission, and the side which has scored the greater number of points at the end of the full period of play wins the game.

American football, while it started from the English Rugby Union rules has developed in many directions so that the game would not now be recognizable to an Englishman. The one thing that he would see that possibly reminded him of Rugby would be that occasionally a man runs in the open field with the ball. But the various formations and the tactics adopted would puzzle him exceedingly. Like the Rugby Union, however, there is some kicking in it, but far less than in the English Association. In the English scrimmage the two lines of forwards push until the ball pops out somewhere, whereas in the American scrimmage the man in the centre who has possession of the ball snaps it out with his hand whenever he is ready to do so to the quarter-back who stands directly behind him and this man passes it to the half-back or full-back or anyone else so long as he does not pass it ahead. This enables the Americans to carry out their very elaborate system of plays because the ball can be absolutely directed at any time to any spot. So perfect has this development become that the quarter-back gives signals for the plays by means of which signals the entire team knows exactly what man is to receive the ball and where he is to run with it when he has received it. Thus the others may assist him very materially in making his gain. Some idea of the variety of plays can be gathered from the fact that teams can without difficulty execute no less than 40 or 50 plays, each distinct from the other. It is not difficult to imagine that with this highly developed form of attack a most thorough and well-studied plan of defense is equally necessary. It is also not difficult to understand that this development on both sides has brought about specialization in the work of various players so that almost every position on the field has a distinct line of duties which its incumbent must be able to perform with skill and accuracy. The signals are quite elaborate codes, devised for easy memorizing, but at the same time sufficiently intricate and bewildering as to render the liability of discovery by the opponents very small.

In the American game the quarter-back usually gives these signals, although the captain sometimes prefers to give them himself.

The history of the game in America as in England and elsewhere has been one of discussion and opposition, the latter coming from those who believe that the sport is too strenuous. Kingly edicts were issued in the old days in England and in the United States State legislatures have been asked at various times to forbid the pastime. Yet it has lived on. In America the game has had already three great epochs as it were. The first in the eighties when the «block game» was legislated out of existence, then in the early nineties when «momentum mass» plays were excised and finally in 1903 when «formation plays» were restricted.

Before the Rules Committee met in that year it sent out a request to those directly interested in the sport of football and to those connected with the boards of control of athletics in various colleges and schools that they offer suggestions concerning the future development of the game and opinions concerning modifications of the

style of play and the revision of the rules. Many letters were received by the Rules Committee, including a communication in response to this request signed by a large number of the head masters of schools. A widespread public sentiment was advanced in favor of such a change in the rules as might bring about more "open play," and it was further felt by the committee and their advisers that the rules should be so modified and the powers of the officials so increased as to eliminate to the greatest possible extent unsportsmanlike tactics, and with these ends in view the committee decided upon the incorporation of two important changes. The first of these was the adoption of such a formation in mid-field between the 25-yard lines as might lead to the development of that open style of play desired by so many. Since, however, it was impossible to predict the character of the play that might result under any specific modifications of the rules, the committee thought it desirable to retain the old style of play within each of the 25-yard lines so that football experts and the public should have opportunity to see the old and the new styles of play side by side, and to thus obtain practical demonstration of the effects of these changes to serve as a guide in further action. The second general change was the incorporation of rules that in some cases greatly increased the penalty for unfair tactics, and in others did away with all excuses for indulgence in certain rough plays, at the same time providing for less offensive armament, as for instance, in the case of the head-gear. To make sure that the wishes of the committee were carried out in this matter, the duties of the linesman were enlarged and he was made practically an assistant to the umpire and given absolute power to deal with certain classes of fouls. The American game thus has for its conduct three officials, the referee whose duties are principally related to the progress of the ball, the umpire who has charge as it were of the conduct of the players, the linesman who acts as a second umpire, at the same time assisting the referee in the matter of measurements.

Walter Camp,
Yale University.

Foote, fůt, **Andrew Hull**, American naval officer: b. New Haven, Conn., 12 Sept. 1806; d. 26 June 1863. He entered the navy as a midshipman in 1822, and in 1849–52 he was engaged in the suppression of the slave trade on the coast of Africa. In command of the China station in 1856, when the Chinese and English were at war, he exerted himself to protect American property, and was fired upon by the Celestials. His demand for an apology was refused and he stormed and captured four Chinese forts. In 1861 he commanded the expedition against Forts Henry and Donelson on the Tennessee and Cumberland rivers, and directed the attack on Island Number 10. In 1862 he was promoted rear-admiral. He wrote 'Africa and the American Flag' (1854). Consult Hoppin, 'Life of Rear Admiral Andrew Hull' (1874).

Foote, Arthur, American composer: b. Salem, Mass., 5 March 1853. He was graduated at Harvard 1874, became a teacher of the piano and organist of the First Church in Boston, and has devoted much time to composition, in which field he has been very successful, having published a cantata 'Hiawatha,' a trio in C major for piano, violin, and 'cello; suites for the orchestra; an overture, 'In the Mountains'; songs, and pianoforte pieces.

Foote, Henry Stuart, American statesman: b. Fauquier County, Va., 20 Sept. 1800; d. Nashville, Tenn., 20 May 1880. He was admitted to the bar in 1822; removed to Mississippi in 1826 and entered politics. In 1847 he was elected to the United States Senate, and in 1852 was elected governor of the State. He was a strong opponent of secession at the convention held at Knoxville, Tenn., in 1859, but when secession was an assured fact, he accepted an election to the Confederate Congress, where he was active in his opposition to most of President Davis' measures.

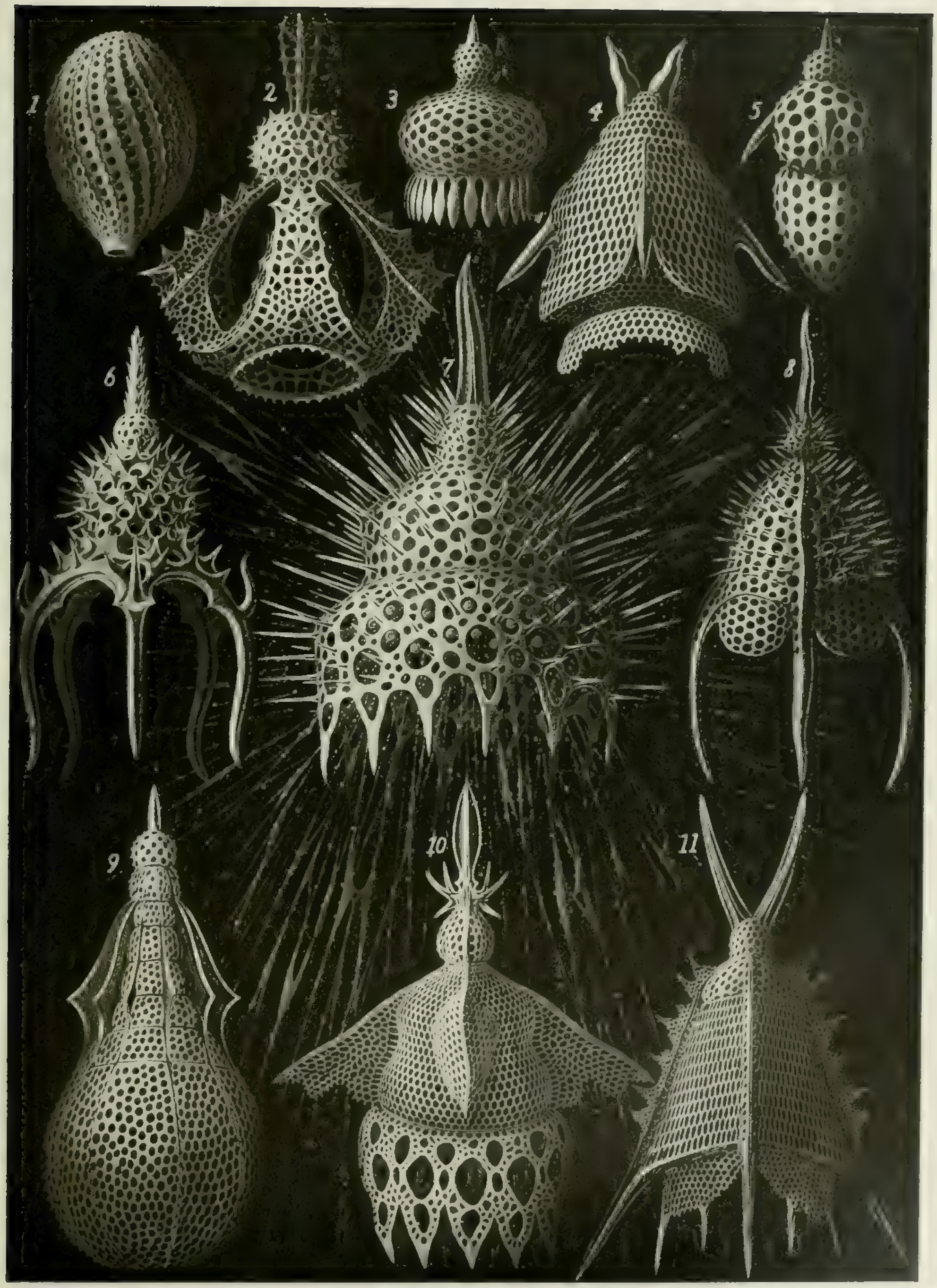
Foote, Lucius Harwood, American diplomatist: b. Winfield, N. Y., 10 April 1826. He was educated at Knox College and at the Western Reserve University; went to California in 1853; and was admitted to the bar in 1856. He became adjutant-general of California in 1861, and was consul to Valparaiso, Chile, 1878–81. Appointed minister to Korea in 1882, he distinguished himself in the protection of Japanese and other foreigners in the nationalist revolt in Seoul in 1883, and received the thanks of the emperor of Japan, the Chinese government, and the emperor of Korea for his services. He resigned in 1884 and returned to California, where in 1890 he was made treasurer of the San Francisco Academy of Sciences.

Foote, Mary (Hallock), American novelist: b. Milton, N. Y., 19 Nov. 1847. In 1876 she was married to Arthur D. Foote, a mining engineer. She has published: 'The Led Horse Claim' (1883); 'John Bodewin's Testimony' (1886); 'The Last Assembly Ball' (1889); 'In Exile and Other Stories' (1894); 'The Chosen Valley'; 'Cœur d'Alène' (1894); 'The Cup of Trembling and Other Stories' (1895); 'The Little Fig Tree Stories' (1900); 'The Prodigal' (1900); etc.

Foote, Samuel, English actor and playwright: b. Truro, England, 27 Jan. 1720; d. Dover, England, 21 Oct. 1777. From Oxford he turned his attention to the stage; tried tragic parts and failed; then began to give entertainments of a sort now familiar but then new, impersonating real and imaginary people and acting little farces by himself. He wrote many farces, the most notable being: 'The Minor' (1760), a skit at the Methodists; 'The Liar'; 'The Mayor of Garratt.' His repartees are famous, and have been collected into a volume.

Foote, Samuel Augustus, American statesman: b. Cheshire, Conn., 8 Nov. 1780; d. there 15 Sept. 1846. He was graduated at Yale College in 1797; served in the legislature for many years; was member of Congress in 1819–21 and 1823–5; served one term in the United States Senate, was governor of Connecticut, and one of the presidential electors on the Clay and Frelinghuysen ticket in 1844. It was he who in 1829 introduced the bill "on the public lands" that occasioned the famous debate between Hayne and Webster.

Footmen, a collector's name for the small gray and yellowish moths of the family *Lithosiidæ*, which have simple antennæ, rather narrow fore wings, beneath which the broad hind wings are folded when at rest.



RHIZOPODS.

[1] Cyrtophormis spirall. [2] Clathrocanium reginae. [3] Anthocyrtium campanula. [4] Pterocorys rhinoceros. [5] Lithornitbium falco. [6] Alacorys Bismarckii. [7] Calocyclas monumentum. [8] Pterocanium trilobum. [9] Stichophaena Ritteriana. [10] Dictyocodon Annasethe. [11] Artopilium elegans.

Foraging Ants, the large, powerful ants of the tropical American genus *Eciton,* which from time to time march in hosts across the country, with the precision of an army under the control of officers. These marching columns are composed almost wholly of workers, apparently directed by a larger, lighter-colored kind; and they search every inch of ground, rubbish-heap or thicket, searching for what they can eat and driving every living thing out of their way in terror. Several species exist, differing in various respects. One, for example, devotes its forays entirely to finding and robbing the homes of a smaller and very different ant (*Hypoclinea*), whose larvæ and pupæ it carries off, but lets the adults go free. Ordinarily no insect that can be caught is spared. These ants have no settled abode, but make nests in hollow stumps, or underground, and change them each season or oftener. Their colonies exhibit a high degree of organization, and contain five separate castes, instead of the three of ordinary ants. See ANTS, and the works referred to thereunder; and especially Belt, 'Naturalist in Nicaragua' (1888).

Foraker, Joseph Benson, American politician: b. near Rainsboro, Highland County, Ohio, 5 July 1846. He enlisted in the 89th Ohio infantry in 1862, participated in the battles of Missionary Ridge, Kenesaw Mountain, and Lookout Mountain and in Sherman's "march to the sea," served on the staff of Gen. Slocum, and was mustered out in 1865 with the rank of first lieutenant and brevet captain. Subsequent to the War he studied for two years at the Ohio Wesleyan University, in 1869 was graduated from Cornell University, and in the same year was admitted to the bar at Cincinnati and there began the practice of law. In 1879 he was elected judge of the superior court of Cincinnati, from which post he resigned in 1882. He was Republican candidate for the governorship of Ohio in 1883, but was defeated by Hoadly, Democrat; was elected in 1885 and re-elected in 1887; and was again defeated in 1889, this time by Campbell. In 1896 he was elected United States senator to succeed Calvin S. Brice, and in 1902 re-elected. He was chairman of the Ohio Republican State conventions of 1886, 1890, 1896, and 1900; a delegate-at-large from Ohio to the national Republican conventions of 1884, 1888, 1892, 1896, and 1900, being chairman of the Ohio delegation in 1884 and 1888; and presented to the conventions of 1896 and 1900 the name of William McKinley for nomination to the Presidency. He attained the largest law practice in southern Ohio, and became well known in that State as a corporation attorney and a vigorous orator on political questions. His election to the Senate at once made him the Republican leader of Ohio. In the Senate he took a prominent part in the discussions connected with the Spanish-American war, of which he was a conspicuous advocate. His name has been mentioned for the Presidential nomination.

Foraminif'era, an order of animals in the phylum *Protozoa* and the class *Rhizopoda.* The body is contained within a calcareous test or shell, which is many chambered. It may be cylindrical or spiral, or it may tend to the pyramidal form. The outer surface presents a punctate or dotted appearance, produced by the presence of very numerous small apertures, or "foramina." The chambers in some are perfectly distinct from others, though so aggregated as to form a compound shell; in others they are connected with a funnel-like tube. The texture of the shell in one group is porcelain-like, in another glassy. The inside of the shell has an extensile and contractile sarcode (protoplasm) of a reddish or yellow color, which streams through the openings and thinly covers the outside. Foraminifers are always of small size, and often microscopic. With the exception of *Gromia* and one or two related genera which occur both in fresh and salt water, they are exclusively marine and many dwell only in the abysses. Sometimes their shells constitute sea-sand. In the Atlantic, at a depth of 3,000 fathoms, there is an ooze composed almost entirely of *Globigerinæ,* which belong to this order. See GLOBOGERINA.

The exceedingly antique *Eozoon* (q.v.) of the Laurentian rocks, if organic, as is generally believed, was apparently a foraminifer. Forms more unequivocal, some of them very like recent species, occur in the Silurian, the Carboniferous, and other strata. They are found through all the Secondary Period, chalk (q.v.) being almost entirely composed of their cases. They increase in number and importance in the Tertiary. The flat, coin-shaped nummulites of the Middle Eocene form the principal bulk of great series of limestone rocks that furnish excellent building-stone. The type of the order has remained wonderfully constant from the earliest times till now.

Foran, Joseph Kearney, Canadian author: b. Aylmer, P. Q., 1857. Among his poems the best known are a 'Lament for Longfellow' and 'Indian Translations.' He is the author of two novels, 'Tom Ellis, a Story of the Northwest Rebellion,' and 'Simon, the Abenakis.' 'The Spirit of the Age' (1894); 'Poems and Canadian Lyrics' (1895).

Forbes, fôrbz, **Archibald,** English journalist and war correspondent: b. Morayshire 1838; d. London 30 March 1900. From 1859 till 1864 he served in the Royal Dragoons, but, abandoning the army for journalism, joined the staff of the *Daily News,* as war correspondent. In this capacity he accompanied the German army through the war of 1870–1, and a little later, in Paris, was present at the downfall of the Commune. He was in India during the 1874 famine, and shortly afterward the Carlist and other troubles kept him for a time in Spain. He accompanied the Prince of Wales on his Indian tour in 1875–6, and on returning described as an eye-witness the Servian war of 1876. In the following year he was with the Russians in their campaign against the Turks, being present at the battle of Plevna, and in 1878 he went to Cyprus. He was under fire during the Afghanistan campaign of 1878–9, next visited Mandalay, and then went to Zululand. He afterward devoted himself mainly to lecturing at home and in America and Australia. His chief publications are: 'My Experiences in the Franco-German War' (1872); 'Glimpses through the Cannon Smoke' (1880); 'Chinese Gordon' (1884); 'Souvenirs of Some Continents' (1885); 'William I. of Germany' (1888); 'Barracks, Bivouacs, and Battles' (1891); 'Havelock' (1891); 'Afghan Wars' (1892); 'Colin Campbell, Lord Clyde' (1895); 'Camps,

Quarters, and Casual Places' (1896); 'Memories and Studies of War and Peace' (1896); 'The Black Watch' (1896); 'Life of Napoleon III.' (1898).

Forbes, David, English geologist: b. Douglas, Isle of Man, 6 Sept. 1828; d. London 5 Dec. 1876. As a civil engineer he traveled all over the world, studying rock formations and fossils, and writing: 'On the Relations of the Silurian and Metamorphic Rocks of the South of Norway' (1855); 'On the Geology of Bolivia and Southern Peru' (1861); and kindred treatises.

Forbes, Duncan, Scottish jurist: b. near Inverness, Scotland, 10 Nov. 1685; d. 10 Dec. 1747. He studied at Paris, Utrecht, and Edinburgh, and rose, in 1737, to the rank of president of the Court of Session. It was mainly owing to his exertions that the rebellion of 1745 was prevented from spreading more widely among the clans; but so ungratefully was he treated by the government, that he was never able to obtain repayment of the various sums he had expended to uphold it. He was the author of: 'Thoughts on Religion'; the 'Culloden Papers'; etc.

Forbes, Edward, English naturalist: b. Douglas, Isle of Man, 12 Feb. 1815; d. Wardie, near Edinburgh, 18 Nov. 1854. He was a brother of David Forbes (q.v.). He became professor of botany in King's College, London, in 1843, and curator of the Geological Society; in 1851 professor of natural history in the School of Mines; and in 1853 he was elected to the chair of natural history in the University of Edinburgh. He did much to advance and systematize special departments of natural history, both by his own labors and by the stimulus which he imparted to his associates and pupils. His classification of the British star-fishes opened a new era in that branch of zoology; and his discovery that air-breathing mollusks lived at the period of the Purbeck beds rectified many erroneous hypotheses. Of his separate works, papers, and monographs upward of 200 were published; among them: 'Star-fishes' (1841); 'The Radiata and Mollusca of the Ægean' (1843); 'Travels in Lycia' (1846); 'Naked-eyed Medusæ' (1847); 'British Mollusca' (1853); 'Literary Papers by E. Forbes' (1855).

Forbes, Edwin, American landscape and genre painter: b. New York 1839; d. Flatbush, L. I., 1895. He was a pupil of A. F. Tait, and became special artist for 'Frank Leslie's Magazine' during the Civil War. The drawings which he made during that time are now in the war office at Washington, and are of historic value.

Forbes, Evelina Louisa Michell, English novelist: b. Tettenhall. She was married to Hon. Walter Forbes in 1888. Her published books include: 'Fingers and Fortune' (1886); 'Her Last Run' (1888); 'Blight' (1897); 'A Gentleman' (1900); 'Dumb' (1901); 'Unofficial' (1902).

Forbes, Harriette Merrifield, American writer: b. Worcester, Mass., 22 Oct. 1856. She was married to W. T. Forbes 5 Feb. 1884. She has published: 'The Hundredth Town' (1889); 'The Diary of Rev. Ebenezer Parkman' (1899).

Forbes, James David, Scottish physicist: b. Colinton, near Edinburgh, 20 April 1809; d. Clifton, England, 31 Dec. 1868. He was admitted to the Scottish bar in 1830; in 1833 was appointed to the chair of natural philosophy in the University of Edinburgh, and in 1860 became principal of the United Colleges of St. Salvador and St. Leonard, in the University of St. Andrews. His fame rests chiefly on his study of glaciers. His chief publications on this subject are: 'Travels through the Alps of Savoy' (1843); 'Norway and its Glaciers' (1853); 'Tour of Mont Blanc and Monte Rosa' (1855); and 'Occasional Papers on the Theory of Glaciers' (1859). Forbes' theory was that glacier ice moves in its channel like a viscous fluid, the middle moving faster than the sides, and the upper portions faster than the lower.

Forbes, John Colin, Canadian artist: b. Toronto, Canada, 23 Jan. 1846. He studied at the Royal Academy, London, England, and on the continent, and returning to Canada he became a successful landscape and portrait painter. Among his works are: 'Foundering of the Hibernia'; 'The Mount of the Holy Cross'; 'The Glacier of the Selkirk'; 'The Lily'; and portraits of Gladstone, Sir John A. Macdonald, the Marquis of Dufferin, Lady Helen Blackwood, and Sir Charles Tupper.

Forbes, John Franklin, American educator: b. Middlesex, N. Y., 13 June 1853. He was graduated at the University of Rochester in 1878; and in 1885 was made president of the John B. Stetson University in Deland, Fla.

Forbes, John Murray, American clergyman: b. 5 May 1807; d. 1885. He was graduated at Columbia College 1827, and at the General Theological Seminary of the Protestant Episcopal Church 1830. He was ordained to the ministry in the year last named, and became rector of St. Luke's Church, New York, 1834. He adopted the Roman Catholic faith in 1849, and was appointed pastor of St. Ann's Church in New York shortly afterward. Returning to his earlier faith in 1859, he was restored to the ministry 1862 and was dean of the General Theological Seminary of the Protestant Episcopal Church 1869–72.

Forbes, John Murray, American merchant: b. Bordeaux, France, 23 Feb. 1813; d. 12 Oct. 1898. He entered a Boston counting room at 15 and in 1834 became a partner in the firm of Russell & Company, china merchants in Boston. He built many clipper ships for the California trade, and was later prominent in railway managements. Naushon, the largest of the Elizabeth Islands, Mass., was owned by him and constituted his summer home where many notables were entertained by him. See Hughes, 'Letters and Recollections of John Murray Forbes' (1899).

Forbes, Stanhope Alexander, English artist: b. Dublin, Ireland, 18 Nov. 1857. He was educated at Dulwich College and studied art at the Royal Academy Schools, and under Bonnat in Paris. Among his pictures exhibited at the Royal Academy are: 'The Fish Sale'; 'The Health of the Bride'; 'By Order of the Court'; 'The Salvation Army'; 'Forging the Anchor.'

Forbes-Robertson, John, English art critic: b. 30 Jan. 1822; d. London 25 Feb. 1903. He was educated at the University of Aberdeen.

went to London at 21, and after visiting various art centres devoted himself to literature and criticism. He has published: 'The Great Painters of Christendom'; and lives of Gustave Dore, Rosa Bonheur, etc.

Forbes-Robertson, Johnston, English actor: b. London 16 Jan. 1853. He is the son of John Forbes-Robertson (q.v.) and has been prominent on the English stage since he was 21.

Force, Manning Ferguson, American soldier and author: b. Washington, D. C., 1824; d. 1899. He was the son of Peter Force (q.v.). He was graduated at Harvard College 1845 and at the Harvard Law School, entering the army in the Civil War as major of the Twentieth Ohio Volunteers, and attaining the rank of brevet major-general of volunteers. He was judge of the court of common pleas of Hamilton County, Ohio, 1867–77, and judge of the superior court of Cincinnati 1877–8. He published: 'From Fort Henry to Corinth' (1881); 'Marching Across Carolina' (1883); 'Personal Recollections of the Vicksburg Campaign' (1885); etc.

Force, Peter, American historian: b. near Little Falls, N. J., 26 Nov. 1790; d. Washington, D. C., 23 Jan. 1868. His life work, entitled 'American Archives,' a valuable collection of 22,000 books and 40,000 pamphlets, was bought by the government (1867) and placed in the library of Congress. He published also: 'Grinnell Land: Remarks on the English Maps of Arctic Discoveries in 1850–1'.(1852); and 'Notes on Lord Mahon's History of the American Declaration of Independence' (1855).

Force, the immediate agency by which the motion of a body is increased or diminished, or changed in direction, or by which such changes are opposed. A force is measured, in theoretical mechanics, by the increase of velocity that it can produce upon a body of unit mass, when it acts upon that body for one second. Suppose, for example, that a uniform force of magnitude F acts for T seconds upon a body of mass M, thereby increasing (or diminishing) its velocity by V units. Then the magnitude of the force is defined by the equation $F = \frac{MV}{T}$. If M is expressed in grams, and V is expressed in centimetres per second, then F, as calculated by means of this equation, is expressed in dynes. If M is expressed in pounds, and V in feet per second, then F, as calculated from this equation, is expressed in "poundals"; the word "poundal" (for which we are indebted to Prof. James Thomson) denoting the force which will increase (or diminish) the velocity of one pound of matter by one foot per second, when it acts upon it for one second. It is known by experiment that when a body falls freely under the influence of gravity, its velocity, at the end of one second, is about 32.2 feet per second. Let the body in question have a mass of M pounds, and let F be the attraction of the earth upon one pound of matter, as expressed in "poundals." Then the total force, F, that is acting upon the body is $F = Mf$; and hence the foregoing equation gives us, for this case (remembering that $T = 1$), $Mf = 32.2M$, or $f = 32.2$; and hence it follows that the attraction of the earth upon one pound of matter is 32.2 poundals in a region where gravity, when acting freely upon a body for one second, increases its velocity by 32.2 feet per second. If we follow the usual custom and represent the accelerative effect of gravity at any place by the letter g (instead of by the particular value 32.2), we may make the following general statement, which may also be taken as the definition of the poundal: In a region in which gravity increases the velocity of a falling body by g feet per second, per second, the earth attracts one pound of matter with a force of g poundals.

A force is said to be "central," when it acts always toward a definite centre, which may be either fixed or in motion. The gravitative forces with which the heavenly bodies act upon one another are of this character, and are often popularly called "centripetal" (that is, "centre-seeking") forces for this reason. When a body is caused to move in a curved path, it exerts a force which acts along the radius of curvature of the path, and in a direction away from the centre of curvature. Forces of this nature are called "centrifugal" (or "centre-fleeing"), and familiar examples are afforded by the pressure of swiftly moving water against the curved vanes of a turbine water-wheel, and by the tension produced in a string when a stone that is attached to the string is whirled rapidly about in a circle. The nature of centrifugal force has been the subject of more or less controversy, some authorities maintaining that it should not be classed as a true force, since it does not produce any acceleration in the direction in which it acts; — that is, a particle on the rim of a swiftly revolving wheel does not fly off radially when it is liberated, but merely continues its motion with unaltered speed, in the direction in which it was moving at the instant of its liberation; — or tangentially to the wheel. The subject is too technical for discussion in this place, but it may be pointed out that such a particle is actually subject to a radial acceleration, if its motion is considered *relatively to the wheel.*

Forces are said to be "conservative" when the principle of the conservation of energy holds true for the systems in which they occur (see ENERGY). All of the forces of nature are believed to be fundamentally conservative, although this has not yet been rigorously proved for the forces that prevail within animals and plants.

A "field of force" is any region in which a given force has a sensible magnitude. A conductor charged with electricity, for example, exerts an attractive (or repulsive) force upon all bodies that are exterior to it, and, from the point of view of theoretical physics, this force still exists at an infinite distance from the charged body, though at such a distance it becomes infinitesimal in intensity. From a practical standpoint, however, the "field of force" due to the charged body can be considered to be limited by an indefinite but finite boundary, whose distance from the body depends upon the intensity of the charge, and also upon the order of minuteness of the forces that can be regarded as negligible, so far as any effect upon the problem that happens to be under consideration is concerned. Within a closed conductor there is no field of electric force, so long as the charges upon the conductor itself, and in the region external to it, are in equilibrium. This fact may be demonstrated mathematically,

and it was also abundantly proved, experimentally, by Faraday. (See ELASTICITY; ELECTRICITY; ETHER; GRAVITATION; MECHANICS; etc.) Consult, also, Mach, 'Principles of Mechanics'; Pearson, 'The Grammar of Science'; Ziwet, 'Elementary Treatise on Theoretical Mechanics.'

Force Bill, a popular name in the United States for four different congressional bills, used at the time of their passage; all aimed at the South, and intended to suppress by national force direct or indirect nullification (q.v.) of national laws. (1) The bill of 2 March 1833 to enforce the tariff law; drawn out by Calhoun's nullification ordinance passed by the South Carolina legislature (See COMPROMISE OF 1833); also called the "Bloody Bill." It was not put in action, because South Carolina first suspended and then repealed the Nullification Ordinance. (2) The bill of 31 May 1870 to put down the forcible resistance which the Southern leaders were preparing to offer to the reconstruction governments. It punished by fine and imprisonment, or both, and gave the Federal courts exclusive cognizance of any interference with the registration, voting, etc., of any one, or going on his premises to intimidate him, or personating him in voting or violating State or Federal election laws, or violating the Civil Rights Bill of 1866. (3) The bill of 20 April 1871 to suppress the Kuklux Klan (q.v.). It gave the Federal courts cognizance of suits against any one depriving another of any constitutional rights; punished as conspiracy any combination to delay the execution of any Federal laws, or deter any one from voting, holding office, or acting as Federal juror or witness; (this clause was held unconstitutional by the Supreme Court); authorized the President to employ the national forces to suppress disorders intended to deprive any class of their constitutional rights, in case the State authorities were unable or unwilling; suspended the habeas corpus "during the continuance of such rebellion" — this provision to remain in force only till the end of the next regular session; authorized the judges to exclude from the juries persons they suspected to be in complicity with the proscribed acts; authorized civil action for damages against all persons who neglected to give warning of such a conspiracy or intended injuries, if they had good reason to suspect them; and confirmed former civil-rights legislation. An attempt was made to extend the fourth suspension of the habeas corpus to May 1872, and the Senate did so, but the House refused. (See RECONSTRUCTION.) (4) The Lodge Election Bill, 2 July 1890, "to amend and supplement the election laws of the United States, and to provide for a more efficient enforcement of such laws." It passed the House, but was tabled in the Senate by a free-coinage fusion of Democrats and Republicans who wished to pass to currency legislation.

Force of Gravity. The determination of the force of gravity from point to point over the earth's surface is a matter of importance. The force of gravity is not the same all over the surface of the earth. It is least at the equator, and it gradually increases as we recede toward the poles. Thus a given mass, if tested by means of a spring-balance of sufficient delicacy, would appear to weigh least at the equator, and would seem to get heavier and heavier as the latitude increases. This is due to two causes: (1) owing to the rotation of the earth on its axis every particle of matter tends to fly off from the surface by centrifugal force. The apparent force of gravity at any place is therefore the force of gravity at that place diminished by the centrifugal force. The centrifugal force at the equator is greater than that in high latitudes, because of the greater radius of the circle described at that place. The second cause is the oblate form of the earth. The earth is not a true sphere, but is flattened at the poles. Hence the distance of any attracted point at the equator from the centre of the mass is greater than that of points situated at or near to the poles; the attraction is, therefore, less at the equator than in high latitudes. Experiments to determine the force of gravity from point to point are made by determining the length of a pendulum, that beats seconds at each place. This being known, the force of gravity is easily calculated. See PENDULUM.

The following table gives the lengths of the seconds pendulum at different places, as determined by various experimenters, and also the force of gravity as deduced from their observations:

THE VALUE OF THE ACCELERATING FORCE OF GRAVITY AT DIFFERENT PLACES.

Observer	Place	Latitude	Length of seconds pendulum in inches.	Acceleration of gravity in feet per second.
Sabine	Spitzbergen	N. 79° 50′	39.21469	32.2528
Sabine	Hammerfest	N. 70° 40′	39.19475	32.2363
Svanberg	Stockholm	N. 59° 21′	39.16541	32.2122
Bessel	Königsberg	N. 54° 42′	39.15072	32.2002
Sabine / Borda	Greenwich	N. 51° 29′	39.13983	32.1912
Biot and Sabine	Paris	N. 48° 50′	39.12851	32.1819
Biot	Bordeaux	N. 44° 50′	39.11296	32.1691
Sabine	New York	N. 40° 43′	39.10120	32.1594
Freycinet	Sandwich Islands	N. 20° 52′	39.04690	32.1148
Sabine	Trinidad	N. 10° 39′	39.01888	32.0913
Freycinet	Rawak Island (Pacific)	S. 0° 2′	39.01433	32.0880
Sabine and Duperrey	Ascension	S. 7° 55′	39.02363	32.0956
Freycinet and Duperrey	Isle of France	S. 20° 10′	39.04684	32.1151
Brisbane and Rümker	Paramatta	S. 33° 49′	39.07452	32.1375
Freycinet and Duperrey	Falkland Islands	S. 51° 35′	39.13781	32.1895

Forcing, in gardening, is a term used to designate a process in which artificial heat is applied so that flowers, fruits, or other products of plants are obtained at a date or season other than that at which they may be had in the ordinary course of culture. Thus, for example, kinds of grapes which by the simple influence of the heat of the sun in a vinery do not ripen till September or October are induced by forcing to ripen in March or later, according to the period the process is commenced; and strawberries, which ripen from June to September, in the forcing-house yield their fruit from February onward. Conducted, as the system is, during the short days of the year, the chief obstacle the gardener has to contend with is diminished light. This in the case of forcing fruits taxes his skill to the utmost, because abundant light is essential both to the proper fertilizing of the flowers and to the perfecting of the fruit. Some vegetables and salads and many flowers are, however, more successfully forced in the dark than in light. Rhubarb, seakale, mushrooms, lily of the valley, lilac, are all forced in greater or less darkness in order the better to develop their individual perfections. See ELECTRIC VEGETABLE GARDENING; HORTICULTURE.

Ford, Edward Onslow, English sculptor: b. London 1852; d. 1901. He studied in Antwerp and Munich, and was made a Royal Academician of London in 1859. His artistic faculty was displayed in felicitous portraiture, and he executed striking statues of many eminent contemporaries, including Gladstone and "Chinese" Gordon. The Marlowe Memorial at Canterbury and the Shelley Memorial at University College, Oxford, are also from his chisel. A monument to his memory was unveiled in Grove End Road, Saint John's Wood, London, 13 July 1903.

Ford, Henry Jones, American editor: b. Baltimore, Md., 25 Aug. 1851. He was graduated from the Baltimore City College in 1868, was connected with the *American* and *Sun* of Baltimore and the *Sun* of New York, and in 1901 became editorial manager of the Pittsburg *Commercial Gazette* and *Chronicle-Telegraph.* He published 'The Rise and Growth of American Politics' (1898).

Ford, James B., American plate-glass manufacturer: b. Kentucky about 1812. He established plate-glass manufactories at New Albany, Ind., and elsewhere, and after a somewhat checkered career became at 78 nearly penniless. He then succeeded in interesting capitalists in his plans and established two immense factories, at Tarentum and Creighton, Pa., and founded Ford City, Pa., building a third large factory there. In 1899 he retired from business with a fortune of $10,000,000. He is said to have been the first person in the United States to discover that natural gas could be used as fuel for manufacturing establishments.

Ford, James Lauren, American journalist: b. St. Louis, Mo., 25 July 1854. He has written several volumes of short stories and essays, among which are: 'Hypnotic Tales' (1891): 'The Literary Shop' (1894); 'Bohemia Invaded'; 'Dolly Dillenback.' He is also the author of two books for young readers: 'Dr. Dodd's School' (1892); and 'The Third Alarm' (1893).

Ford, John, English dramatist: b. Devonshire 1586; d. after 1639. He printed his first tragedy of the 'Lover's Melancholy' in 1629. This, however, was not his first play, as a comedy of his, entitled 'A Bad Beginning has a Good End,' was acted in 1613. His genius is seen at its highest in the tragedy, ''Tis Pity Shee's a Whore' (1633), though the subject is repulsive. He wrote, or assisted to write, at least 11 dramas. Most of these were exclusively his own composition; but some of them were written in conjunction with Decker and others. Other plays by him are: 'The Broken Heart' (1633); 'Love's Sacrifice' (1633); 'Perkin Warbeck' (1634); 'The Fancies Chaste and Noble' (1638); and 'The Ladies' Trial' (1638). His genius was most inclined to tragedy, but he was too fond of an accumulation of tragic incidents. Besides the works already mentioned, he wrote an able little manual, entitled 'A Line of Life, pointing out the Immortalitie of a Vertuous Name' (1620). In 1827 Gifford issued an edition of Ford's works, which was revised and reissued by Dyce in 1869. There is also an edition of Ford and Massinger by Hartley Coleridge. 'The Broken Heart,' edited with notes by C. Scollard, appeared in 1894.

Ford, John Donaldson, American engineer: b. Maryland. He entered the United States navy as third assistant engineer in 1862 and during the Civil War took part in several important engagements. Later, after having served on many expeditions, he was detached and ordered to Baltimore for the purpose of organizing the Baltimore Manual Training School. In 1890 he was made a chief engineer in the navy; was assigned to duty on the Brooklyn in 1896; and in 1898 joined the Asiatic fleet and took part in the destruction of the Spanish fleet and batteries at Cavite.

Ford, John Thomson, American theatrical manager: b. Baltimore, Md., 1829; d. 1894. He was manager of the Holliday Street Theatre, in Baltimore, of which city he was acting mayor for two years. Among the three theatres he built at Washington, D. C., was the well-known Ford's Theatre (q.v.), the scene of the assassination of President Lincoln. He was arrested as an accomplice of Booth, but as there was absolutely no ground for the accusation he was discharged. In 1871 he built Ford's Grand Opera House at Baltimore.

Ford, Paul Leicester, American author: b. Brooklyn, N. Y., 23 March 1865; d. New York 8 May 1902. Besides numerous pamphlets relating to American historiography his works include: 'The Honorable Peter Stirling' (1894), a novel of New York society; 'The True George Washington' (1896); 'Bibliotheca Hamiltonia'; 'Franklin Bibliography'; and an edition of the works of Thomas Jefferson (1897), with notes, biographical introduction, etc.; 'The Story of an Untold Love'; 'Tattle Tales of Cupid'; 'Short Stories'; 'Janice Meredith' (1899); 'Wanted — a Matchmaker'; etc.

Ford, Sallie Rochester, American story-writer: b. Rochester Springs, Boyle County, Ky.,

1828. She was married to S. H. Ford (q.v.) in 1855, and with him edited the 'Christian Repository' and the 'Home Circle' for many years. Among her published works are: 'Grace Truman' (1857); 'Mary Bunyan' (1859); 'Morgan and His Men' (1864), and 'Ernest Quest' (1887); 'The Inebriates'; etc.

Ford, Washington Chauncey, American statistician: b. Brooklyn, N. Y., 16 Feb. 1858. He is a brother of P. L. Ford (q.v.). He was chief of the bureau of statistics, Department of State, 1885–9, and of the bureau of statistics in the Treasury Department in 1893–8; was connected with the Boston Public Library 1897–1902, and was chosen lecturer on statistics in the University of Chicago in 1901. He published: 'American Citizen's Manual'; 'The Standard Silver Dollar' (1884); 'George Washington' (1899).

Fordham, fôr'dam, a part of New York in the borough of Bronx. Prior to 1874 it was a village in Westchester County, N. Y. Fordham was made a manor in 1671. St. John's College is located here. The poet E. A. Poe lived in Fordham for a number of years and wrote 'The Bells' and other pieces here.

Ford's Theatre, a Washington theatre in which President Lincoln was shot by the assassin, Booth, 14 April 1865. The United States government purchased the building in 1866, and it was at first used as the Army Medical Museum, but after 1887, as the Pension and Records Bureau of the War Department. It gradually fell into ruin, however, and suddenly collapsed with the loss of several lives, 9 June 1893.

Fordun, John of, known as the father of Scottish history: b. probably at Fordoun, Kincardineshire, about 1310; d. about 1386. He wrote the first five books of his 'Chronica Gentis Scotorum,' bringing the history down to the middle of the 12th century, and also a part of the sixth volume, which was completed by Walter Bower, abbot of the monastery of Inchcohn. He enlarged the first five books and added 11 new ones, bringing the history down to 1437. Several editions have been printed, the best probably being that of W. F. Skene (Edinburgh 1871–2).

Forearm. See ARM.

Forecasting the Weather. See METEOROLOGY.

Foreclosure is the right of a mortgagee, or of any one having interest in a mortgage, in the event of the conditions of the mortgage being violated, to compel the mortgagor to redeem the pledge or forfeit his right of redemption. This is done by filing a bill for foreclosure. The court may, on application of the mortgagee, mortgagor, or any incumbrancer of the mortgage, grant, under certain conditions, a sale of the subject instead of foreclosing the mortgage, the money raised by the sale being applied to the payment of the mortgage, any surplus being claimed by subsequent mortgages, or in the event of no other claim, being paid to the mortgagor.

Forefathers' Day, the day celebrated as the anniversary of the landing of the Pilgrims; first commemorated in 1769. Owing to a mistake in the change of Old Style (11 December) to New it was made 22 instead of 21 December.

Foreign Coins and Their American Equivalent. As the monetary value of national coins is subject to frequent change, it is impossible to prepare a statement which would correctly specify the value of any particular coin at any future time. As such changes are correspondingly slight, however, the following list of the coins of all nations will always be comparatively correct, the values in the moneys of account of the United States having been corrected to 1 April 1905 by the director of the mint, United States Treasury Department:

Argentine Republic.— Gold coins: argentine ($4.824) and half argentine; silver coins: peso ($0.965) and its divisions.

Austria-Hungary.—By a law passed 2 April 1892 the monetary system of Austria-Hungary was reformed on a gold basis, with the crown ($0.203) as a unit. The coins issued under the old system are still in circulation, however. They are, gold: eight florins ($3.858), 4 florins, ducat ($2.287), and 4 ducats; silver: florin ($0.5052) and 2 florins. The coins under the new system are, gold: twenty crowns ($4.052), 10 crowns, and 1 ducat ($2.287); silver: one crown ($0.203); nickel: twenty hellers ($0.0405) and 10 hellers; bronze: two hellers, or one kreutzer ($0.0040), and one heller.

Belgium.— Belgium being a member of the Latin Union, its monetary unit is the franc ($0.193), and its coins the gold 10 and 20 franc pieces and the silver 5 francs.

Bolivia.— The boliviano ($0.439) is the monetary unit of Bolivia. Its coins, all silver, are the boliviano, the 50, 20, 10, and 5 centavo ($0.0211) pieces.

Brazil.— The milreis ($0.546) is the monetary unit of Brazil. Its gold coins are 5, 10, and 20 milreis pieces; its silver coins, ½, 1, and 2 milreis.

Bulgaria.— The monetary unit is the lev ($0.185) which is supposed to correspond to the franc of other double standard countries. In fact, but few Bulgarian gold coins are in circulation, the necessary gold coins being supplied by foreign 10 and 20 franc pieces. The silver coins are the ½, 1, 2, and 5 leva pieces; the nickel coins are the 2½, 5, 10, and 20 stotinki ($0.0385), and there are copper coins of 1, 2, 5, and 10 stotinki.

Canada.— The gold dollar ($1) is the monetary unit. The silver coins are the 50, 25, 10, and 5 cent pieces. Some penny (2 cents) and half penny pieces are in circulation.

Chile.— The value of the peso, the monetary unit, is ($0.365). The gold coins of the country are the escudo ($1.825), doubloon ($3.65), and the condor ($7.30). The peso and its divisions are coined in silver.

China.— The monetary system of China is in an extremely chaotic condition. The unit and sole official coinage is the copper cash, 11 of which are equal to one cent. The silver tael, or liang, varies in value in different parts of the country, as follows:

THE CHINESE TAEL.

PLACE	Value	PLACE	Value
Amoy	$0.719	Nankin	$0.712
Canton	0.717	Ninchwang	0.674
Chefoo	0.688	Ningpo	0.691
Chin Kiang	0.703	Pekin	0.701
Fuchau	0.665	Shanghai	0.657
The Haikwan or customs tael	0.732	Swatow	0.664
		Takau	0.724
Hankow	0.673	Tientsin	0.697

In Hong Kong and Labuan, the "British Dollar" has the same legal value as the Mexican dollar.

Colombia.— The gold dollar ($1.) is the monetary unit. Other gold coins are the condor ($9.647) and the double condor. The silver peso ($0.9352) and its divisions are coined.

Costa Rica.— The gold colon ($0.465) is the unit of the country. Two, 5, 10, and 20 colon pieces are coined in gold; 5, 10, 25, and 50 centimor ($0.2326) pieces in silver.

Cuba.— As Cuba is a gold standard country, its monetary unit, the peso, is a gold coin valued at $0.91. The gold doubloon, valued at $5.017, and the Alphonse, valued at $4.823, are also used, as well as several for-

eign coins. The silver coinage of Cuba is the peso ($0.455) and its divisions.

Denmark.— The monetary unit is the crown ($0.268) and gold 10 and 20 crown pieces are coined. The minor coinage, in silver and bronze, is represented by the 50 ore ($0.1247) and its divisions.

Ecuador.— The gold sucre ($0.487) is the unit, but the 10 sucrae piece is the only gold coin. The minor coinage, the 10 and 5 real ($0.0467) pieces, is of silver.

Egypt.— The gold pound, representing 100 piasters ($4.943) is the unit, and 50, 20, 10, and 5 piaster pieces are also coined in gold. The silver coinage is represented by the 1, 2, 5, 10, and 20 piaster pieces.

Finland.— The markkaa ($0.193) is the monetary unit, and the gold coins are 20 and 10 markkaa pieces. The 50 penni ($0.0794) and the 10 and 1 penni ($0.0019) pieces, in bronze, constitute the smaller coinage.

France.— The gold franc, valued at $0.193, is the unit of the country. Gold 5, 10, 20, 50, and 100 franc pieces, and silver 5 and single franc pieces are coined. The minor coinage is represented by the 50, 20, 10, and 1 centime ($0.0019) pieces.

German Empire.— The gold mark ($0.238) is the unit, and 5, 10, and 20 mark pieces are coined in gold. The 50 pfennigs ($0.1039) and the thaler ($0.6928) represent the silver, the 5 pfennigs, the nickel, and the single pfennig the bronze coinage.

Great Britain.— While the monetary unit for the colonies varies, that for Great Britain itself is the gold pound sterling ($4.8665). The pound sterling (the sovereign), and the half sovereign are coined in gold; the crown ($1.0872), half crown, florin ($0.4348), shilling ($0.2174), sixpence ($0.1017), four pence ($0.0724), three pence ($0.0543), and the two pence ($0.0362) in silver, with the penny ($0.02), half penny, and farthing ($0.005) in bronze.

Greece.— The drachma ($0.193) is the monetary unit. Five, 10, 20, 50, and 100 drachma pieces are coined in gold, 5 drachma pieces in silver, 20 and 5 lepta ($0.0096) in nickel, and 1 and 2 lepta pieces in bronze.

Guatemala.—The silver peso ($0.439) is the monetary unit and this coin and its divisions are coined in silver.

Haiti.— The gourde ($0.965) is the unit of the country; 1, 2, 5, and 10 gourde pieces are coined in gold, and the single gourde and its divisions in silver. The smaller coin is the bronze centime ($0.0096).

Hawaii.— Same as United States.

Honduras.— The peso ($0.439) is the monetary unit and this coin and its divisions are coined in silver.

India.— The pound sterling, or sovereign, is the standard coin of India, but the rupee ($0.324433) and its divisions is the money of account.

Italy.— The lire ($0.193) is the monetary unit. The 5, 10, 20, 50, and 100 lire pieces are coined in gold; 5 lire pieces in silver, while the 20, 10, and 1 centesimo ($0.0019) in nickel and bronze represent the minor coinage.

Japan.— The yen ($0.498) is the unit of the country. Gold 5, 10, and 20 yen pieces are coined; 10, 20, and 50 sen ($0.448) silver pieces, with 5 sen, 1 sen, and 5 rin ($0.0024) pieces in bronze.

Liberia.— The only official coin of Liberia is the gold dollar ($1.).

Mexico.— The silver dollar, valued at $0.458, has long been the monetary unit of Mexico, but a change to the gold standard, which is about to be established, will give the country a gold dollar of the value of about fifty cents. The several divisions and multiples of the dollar will also be coined.

Netherlands, The.— The gold florin ($0.402) is the monetary unit. Gold 10 florin pieces are coined as well as ½, 1, and 2½ florin pieces in silver. The cent ($0.004) is of bronze.

Newfoundland.— The gold dollar of Newfoundland is valued at $1.014.

Nicaragua.— The silver peso ($0.439) is the unit, and this coin and its divisions are coined in silver.

Norway.— Same as Sweden.

Panama.— The balboa, valued at $1. in gold, is the monetary unit. At present no gold is coined, the only coin being the silver dollar ($0.50) and its divisions.

Paraguay.— The country has no coinage, but the silver pesos of other South American republics circulate there at the same value as in the countries where they are issued.

Persia.— The silver kran ($0.078) is the monetary unit. Gold ½, 1, and 2 tomans ($3.408) pieces, and silver ¼, ½, 1, 2, and 5 krans are coined. The copper coins are the chai ($0.0085) and the abassi, valued at 4 chais.

Peru.— The sol ($0.487) is the monetary unit. Gold libra ($4.8665) are coined, as well as the silver sol and its divisions.

Philippine Islands.— By act of the 57th Congress the authorized coins of the Philippines are silver pesos of 10, 20, and 50 centavos (cents) value, and of copper ranging from ½ cent to 5 centavos in value.

Portugal.— The milreis ($1.08) is the monetary unit and 1, 2, 5, and 10 milreis pieces are coined in gold. The silver coins of this country are 1,000 reis ($0.9526) and 50 reis; the nickel coins, 100 reis and 50 reis, and the bronze coins, 20 and 5 reis.

Rumania.— The gold lei ($0.193), corresponding to the franc, is the monetary unit. Twenty and 10 leis pieces are coined in gold, 5 and single lei pieces in silver, and 10 and 1 bani ($0.0019) pieces in bronze.

Russia.— The ruble ($0.515) is the monetary unit. Gold imperials, valued at 15 rubles, and half imperials are coined. The ruble, as well as the 50 and 5 copeck ($0.0187) pieces, are of silver, while the single copeck and a 5 copeck piece are coined in copper.

Salvador.— The silver peso ($0.439) is the unit, and this coin and its divisions are coined in silver.

Servia.— The dinar ($0.173) is the monetary unit. The 20 and 10 dinar pieces are of gold; the 5 and 1 dinar pieces of silver, while the 20, 10 and one para ($0.0019) pieces, in nickel and bronze, represent the minor coinage.

Siam.— The monetary unit is the silver fical ($0.28). The other coins current are the salung (¼ fical) and the juang (⅛ fical).

Spain.— The peseta ($0.193) is the monetary unit. The several divisions and multiples of the peseta are coined in gold and silver, while the minor coinage, ranging from one centimo ($0.0019) to 50 centimos, are of silver or bronze.

Sweden and Norway.— The gold crown ($0.268) is the unit, and 10 and 20 crown pieces are coined in gold. The silver coinage includes the 2 crown piece, the single crown, and the 50 and 10 ore ($0.0241), while the single and the 5 ore pieces are of bronze.

Switzerland.— The gold franc, valued at $0.193, is the monetary unit. Gold 5, 10, 20, 50, and 100 franc pieces, and silver 5 and one franc pieces are coined. The minor coinage includes the 50, 20, 10, and single centimes ($0.0019).

Turkey.— The piaster ($0.044) is the monetary unit and the gold coins include the 25, 50, 100 (the lira), 250, and 500 piaster pieces. The ½ piaster, the single piaster, and the 20 piaster pieces are of silver, while a piaster and the para ($0.0001) are of copper.

Uruguay.— The peso ($1.034) is the only gold coin authorized in Uruguay, but the silver peso ($0.403) and its divisions are also coined.

Venezuela.— The bolivar ($0.193) is the monetary unit. Gold 5, 10, 20, 50, and 100 bolivar pieces are coined, while the silver coinage includes a 5 bolivar piece as well as the single bolivar and its divisions.

Foreign Judgment, in law, is the term applied to the judgment of a foreign tribunal. Such judgment is proved in common law by exemplifications certified under the great seal of the state or country where the judgment is recorded, or under the seal of the court where the judgment remains; the fulfillment of its conditions depends upon treaty stipulations or on international comity. With regard to judgments in courts of sister States of the United States, it is enacted by the acts of 26 May 1790, and 27 March 1804, that they shall be proved or admitted in any other court within the United States, by the attestation of the clerk and the seal of the court annexed; together with a certificate of the judge, chief-justice, or presiding magistrate, as the case may be, that the said attestation is in due form; and that such records and judicial proceedings shall have such faith and credit given to them in every court within the United States as they have by law or usage in the courts of the State from whence they are or shall be taken.

Foreign Laws, the laws of a foreign country. The courts do not judicially take notice of foreign laws; and they must, therefore, be proved as facts. Exemplified or sworn copies of written laws and other public documents must, as a general thing, be produced when they can be produced; but should they be refused by the competent authorities, then inferior proof may be admitted. The effect of foreign laws, when

proved, is probably referable to the court; the object of the proof is to enable the court to instruct the jury what is, in point of law, the result from foreign laws to be applied to the matters in controversy before them. The court is, therefore, to decide which is the proper evidence of the laws of a foreign country, and when evidence is given of those laws, the court is to judge of their applicability to the matter in issue.

Foreign States. In law, every nation is foreign to all other nations; and the several States of the American union are foreign to each other, with respect to their municipal laws. The reciprocal relations between the national government and the several States, however, are considered not as foreign, but as domestic.

Foreign Trade. While political economists have engaged in fierce disputations over many economic theories regarding money, wages, distribution and similar subjects, they have allowed the theory of international trade, as it was set forth by John Stuart Mill, to remain unchallenged and unchanged. The principle involved is one of advantage. In general, a given nation will export those articles in the production of which it has an advantage over other nations and import such articles as can be produced cheaper by other nations. This advantage may be absolute, depending upon location, soil, climate, etc., or it be merely relative and artificial, depending, for instance, on a system of protective tariff.

Modern international trade, in all its vastness and complexity, is a comparatively recent development. It may be said to have first begun with the multiplication of steamships and the extension of railroads throughout the world. Among important recent changes affecting foreign trade, and destined to affect it even more in the future, may be mentioned: (1) The acquisition by the United States of Hawaii and the Philippine Islands; (2) the construction of the Trans-Siberian Railway; (3) the expansion of steam-carrying trade on the Pacific; (4) the opening of China; (5) the definite assurance of a Panama Canal by the United States. These changes mean new markets for us, with better and cheaper facilities of transportation. The location of Manila makes it the logical collecting point for all articles of trade in southern Asia except tea, and under American control, with changed conditions of shipping, this city is destined to become a great commercial emporium. The fact that our factories are located on the Atlantic coast has placed us at a disadvantage in the oriental trade. This condition will be greatly alleviated by the construction of the Panama Canal; not to mention the advantages we shall gain in our trade on the west coast of South America. Indeed, the trade of that group of countries lying south of us is important. They buy of us manufactures and food-products. Their principal employment being agriculture, they form one of the most important groups of those nations known to political economists as "neutral markets." In recent years special efforts have been made to cultivate the South American trade. Witness, for instance, the assembling of the International American Conference, under act of our Congress for the explicit purpose of extending inter-American trade; the completion by an American company of telegraphic communication with the southermost cities of South America; the appointment of an inter-American commission to report on a route for an inter-continental railway; the establishment of the Bureau of American Republics for the publication of information for those engaged in American trade; the unification of customs regulations and the monetary conference to study plans for facilitating inter-American exchange; the unanimous recommendation of all the republics to establish an international American bank, with branches in every American republic; the celebration of treaties of reciprocity and the proposal to establish a permanent inter-American court of arbitration for the settlement of all American disputes; and finally, the opening of our great consuming market to our sister republics by continuing the free admission into the United States of coffee, rubber, nitrate of soda and other products, and by the removal of the duties on hides, sugar and wool. In addition to these means of promoting trade must be mentioned the activity and persistence of our American merchants and manufacturers in advertising their wares, and in this way stimulating the market for them.

Nor have our commercial leaders proved less equal to the demands of international trade in the widest sense. In the trade of the world the United States has taken an important place. In fact, the development of our foreign commerce has been almost phenomenal. It is interesting to examine the figures giving the total values of our imports and exports by decimal periods for the past fifty years, and to note the rate of increase:

Imports.

1855	$257,808,708
1865	238,745,580
1875	533,005,436
1885	577,527,329
1895	731,969,965
1905	1,117,512,629

Exports.

1855	$218,909,503
1865	166,029,303
1875	513,442,711
1885	742,189,755
1895	807,538,165
1905	1,518,561,720

With few exceptions the volume of our foreign trade has increased steadily year by year, the figures for the fiscal year 1905 showing the largest imports and exports. For the fiscal year 1904 the imports and exports were $991,087,371 and $1,460,827,271, respectively. The gain of $126,425,258 in imports alone almost equals the total volume of our foreign commerce in 1812, the year in which the United States first made a clear start in the race for recognition as a world power.

The gradual increase of exports over im-

ports is noteworthy and important. Roughly, from 1855 to 1905 imports have increased fourfold, while exports have increased sevenfold. Whereas in 1855 there was a trade-balance of $40,000,000 against us, in 1905 there was a balance of $400,000,000 in our favor. It is further significant that about half of our imports are manufacturers' materials. See COMMERCE; COMMERCE, INTERSTATE; COMMERCIAL ORGANIZATIONS; COMMERCIAL TREATIES; EXPORTS AND IMPORTS, AMERICAN; EXPORTS AND IMPORTS OF THE LATIN-AMERICAN REPUBLICS; ALASKA, COMMERCIAL; CANADA, COMMERCE, TARIFFS AND TRANSPORTATION; UNITED STATES: FOREIGN COMMERCE OF; HISTORY OF THE TARIFF; RECIPROCITY; COMMERCIAL DEVELOPMENT; FINANCES OF THE, ETC.; FREE TRADE; BALANCE OF TRADE.

Foreign Wars, Military Order of, a national patriotic society founded in 1894 in New York, under the name of the Military and Naval Order of the United States, but known from 1895 by its present designation. The objects of this order are (1) to preserve and honor the memory of those who assisted in the maintenance of the government of the United States in the Revolution, the war with Tripoli, the War of 1812, the Mexican war, and the Spanish-American war; and (2) to collect all records and documents appertaining to the wars above mentioned. The order is sub-divided into 22 State commanderies, and includes in its membership commissioned officers of the army, navy, or marine corps who took part in any of these wars (Veteran Companions), and direct lineal descendants of commissioned officers in the main line (Hereditary Companions). The present membership (1903) exceeds 1,600.

Fore'lands, North and **South,** two headlands on the southeast coast of England, county of Kent. North Foreland projects into the sea in the form of a bastion, and consists of chalky cliffs nearly 200 feet high. South Foreland consists also of chalky cliffs, and has two lighthouses, with fixed lights, erected upon it.

Forensic Medicine. See MEDICAL JURISPRUDENCE.

Foreordination, or **Predestination,** a term appropriated by theology; in the Calvinistic system, the assignment of the Deity, at the time of creation, of some of his creatures to eternal life and happiness and others to eternal death or suffering. Of course the decree was not, as usually stated, irrespective of the spiritual merits of the subjects; but if human beings it was irrespective of their actual conduct on earth. This was supposed to be irrelevant, as through the fall of Adam they had lost all possibility of merit, and owed any escape they might have from utter destruction to God's grace and Christ's vicarious atonement, which restored some of them to moral health. As none of them deserved anything, there could be no injustice in leaving such as he chose to suffer the penalty assigned. The first noun or its verb is not taken from the Scriptures, which uses «ordain» instead (Acts xiii. 48; Jude iv. 13). It was not alone Adam's dereliction which had caused this liberty of choice, however, as angels were included: the Westminster Confession says, «By the decree of God, for the manifestation of his glory, some men and angels are predestinated unto everlasting life, and others foreordained to everlasting death.» This implies that no created being has any claim to other than destruction except by divine grace.

Foreshortening, in art, the method of drawing in strict accordance with the rules of perspective, by which objects are so represented as to convey to the observer an idea of their just length, although but a portion of that length is actually given. The method was known to the ancients, and in more recent times has been notably employed by Correggio.

Forest-fly, the British name for the minute parasitic, flea-like flies called bird-ticks, bat-ticks, and the like, in America; specifically *Hippobosca equina,* which is especially a torment to horses by thrusting its long beak through the skin and sucking the blood. See BIRD-TICK.

Foresters, Ancient Order of, a fraternal order founded 1745, at Yorkshire, England, with a membership 1903 of over 1,000,000, divided among 9,000 courts. The order was introduced into the United States in 1832, and despite the fact that over 175,000 members withdrew and organized the Foresters of America in 1895, the order in this country has a membership of 187,000.

Foresters of America, a fraternal, benevolent order known under this title since September 1895. Orignally the order was part of the Ancient Order of Foresters (1745), but freed itself from the High Court of England (1889), and became a separate order. There were 1,600 courts in 1902, with a membership of 195,200.

Foresters, The Independent Order of, was organized in 1874 in New Jersey. It was reorganized in Canada by the Hon. Dr. Oronhyatekha, a full-blooded Mohawk Indian of scholarly distinction, high character, and great ability, who was educated under the patronage of the present king of England, in 1881. In 1881 the society consisted of 369 members and was in debt. It now numbers 214,000 and has a surplus of $6,700,000 in its treasury, having already paid to widows and orphans of deceased brethren about $14,000,000. The membership extends throughout all of the provinces of Canada, nearly all of the States of the American Union. England, Ireland, Scotland, Wales, Norway, Denmark, France, Belgium, India, Newfoundland, and Australia. In 1902 it added to its membership 13,000, and for the first half of 1903 its net increase was about 9,000. During the year 1902 the number of members initiated was 100 per month greater than in 1901. The death rate of the year was 6.60 per 1,000 or a fraction less than the year before. The average age of its membership at the close of 1902 was a little over 36. The society rejects a large percentage of applicants, being very careful in the selection of its risks. Its accumulated funds increased during 1902 by $957,239. This meant a betterment in assets of 18.19 per cent. The increase in assurance at risk during the year was 4.52 per cent. The increase in the premium income of the order in 1902 was 8.37, while the demands upon that income for the purpose of meeting claims was only 1 per cent greater than in 1901. The order is governed by a supreme body, which meets once in three years. The local jurisdictions are governed by high courts of the various States and Prov-

inces. The funds, however, are all forwarded to the head office, there being invested under the insurance law of Canada which prevents investment in anything except first-class gilt-edge securities. The last reports show that no losses have ever been made in investments. The head office of the order is in Toronto, Canada, the building being a magnificent structure known as the Temple Building, which was built and is owned by the order. In addition to the head office it contains a number of banks, loan companies, insurance companies, and is the headquarters of masonry for the city of Toronto. The order pays out daily (1903) $6,500 to widows and orphans. The rates of premium may be judged from the following: Age 35; amount $1,000; mortuary premium $1.38 (small court dues in addition). All premiums cease at 70 years of age, or at any time when the members become totally and permanently disabled, at which time they are allowed to take in cash one half of the amount of their policy, the balance to be paid to their heirs at death. After 70 years of age members are permitted to draw one tenth of their policy for each of 10 years if they live so long, the balance to go to their beneficiaries at death. The order also has a sick and funeral benefit division. It admits lady members, these being called companions, who are gathered in separate courts. Of its total membership of 214,000 about 17,000 are companion members. The growth and progress of the institution is the life work of Hon. Dr. Oronhyatekha. He has been supreme chief ranger for 22 years and is a man of wonderful strength and power. Associated with him are the following: Hon. Judge Wedderburn, Hampton, N. B.; J. D. Clark, Dayton, Ohio; John A. McGillivray, K. C., Toronto, Ont.; H. A. Collins, Toronto, Ont.; T. Millman, M.D., M.R.C.S., Toronto, Ont.; Hon. Elliot G. Stevenson, Detroit, Mich. Benj. Greer, London, Ont., and Charles A. Fitzgerald, Buffalo, N. Y., are the supreme auditors.

Forestry in the United States. Forestry is the art of using the forest continuously to meet the needs of men. In the United States forestry has to do principally with the supply of wood for various purposes, with the maintenance of waterflow in streams, with the prevention of floods, and with the supply of forage for grazing animals within the forest. Nowhere else are forest problems of more vital importance to the welfare of the people than here, and in no other country of similar civilization has so little progress been made in their solution. This condition follows naturally from the vast area of the United States, its comparatively sparse population per square mile, and from the nature, location, and extent of the forests themselves.

The forests of the United States occupy an area of approximately 1,100,000 square miles, or about 36 per cent of the total land surface. They may be divided into five principal regions.

(*a*) The *Northern Pine Forest* extends from western Minnesota east to the Atlantic Ocean and southward to middle Tennessee, northern Georgia, central Virginia, and northern Maryland. Its characteristic tree is the white pine (*Pinus strobus*, Linn.), a tree of the very first commercial importance, which has hitherto supplied much more of the lumber cut in the United States than any other tree. In its western and more important centre of distribution in Michigan, Wisconsin, and Minnesota, the white pine is found both in pure stands and associated with other, principally hardwood, trees. The cut of white pine in the northern pineries reached its maximum in 1890, when the production for Michigan, Wisconsin, and Minnesota was 8,597,623,000 feet. During the census year 1900 the cut had fallen to 5,419,333,000 feet. This reduction in the cut has been accompanied by so marked a fall in the quality of the lumber that at present very many mills are sawing logs of which 50 or 60 are required to produce 1,000 feet of lumber, while the former average of logs to the thousand was seven or less. In the eastern part of the Northern Pine Forest red spruce (*Picea rubens*, Sarg.) is now the principal lumber tree, since the majority of the merchantable pine has been removed. The spruce grows usually in mixture with hardwood trees such as birch, beech, and maple. Formerly used mainly for lumber, spruce is now cut principally for paper pulp. The production of spruce pulp wood in the census year 1900 was 1,160,118 cords, the majority of which was used for news and other coarse grades of paper. In its southern extension the white pine forest penetrates the extensive hardwood belt of the Southern Appalachians, into which it merges as the white pine and its associates cease to be the characteristic trees. In its northern portion the white pine forest is predominantly of value for the production of wood. Its use as a regulator of stream-flow, while very great, is there far less conspicuous than along its southward extension in the Appalachian Mountains, and in many other forest regions of the United States. The loss from floods in streams which head within this forest in the Southern Appalachian Mountains during a certain period of 12 months ending in 1902 was, according to official estimates, more than $18,000,000. Congress has been asked to undertake the control of these floods by the purchase of lands for a Southern Appalachian forest reserve, but the plan, although thoroughly good, has not yet been carried through.

(*b*) The *Interior Hardwood Forest* follows the southern boundary of the Northern Pine Forest from the edge of the treeless region eastward to the mountains of Virginia and southward along the Appalachian Mountains and the Piedmont region, skirting the northern boundary of the Southern Pine Forest until it meets the prairie in western Texas. Its principal trees are the oaks. It is in this forest that the black walnut, now almost exhausted as a timber tree, reached its best size and most important distribution.

(*c*) The *Southern Pine Forest* extends from northern Maryland south along the Atlantic and Gulf coasts and up the valleys of the principal rivers until it meets the open country in western Texas. Its most important and characteristic tree is the longleaf pine (*Pinus palustris*, Mill.), in many respects the most valuable and important timber pine of the globe. Frequently associated with the longleaf pine, and serving elsewhere to delimit the boundaries of the Southern Pine Forest, is the loblolly or rosemary pine (*Pinus taeda*, Linn.), a tree of rapid growth and great dimensions. Other characteristic trees are the shortleaf pine (*Pinus echinata*, Mill.), which occupies the higher ground back from salt water, and the bald cypress (*Taxodium*

distichum, Linn.), a swamp and tideland tree of high commercial importance, whose wood, for many purposes, is taking the place of the white pine, as clear lumber from that tree becomes progressively scarcer and higher in price. The cut of pine in the Southern Pine Forest in 1900 was 8,523,000,000 feet, and it is increasing with great rapidity. The cut of cypress in 1900 was 495,000,000 feet. The naval stores produced from the longleaf pine in 1900 were valued at $20,344,888.

Along the western border of the Northern Pine Forest, the Interior Hardwood Forest and the Southern Pine Forest extend the region of the Great Plains, destitute of timber except along the margins of the streams and on occasional elevations. There is a strong probability (and in many places conclusive evidence) that great areas of this region at one time bore trees and are still capable of growing forests. The clothing of such areas again with trees is one of the most important problems to be attacked and solved by the American forester. Ultimate success, of which there is now no doubt, will be of enormous value to a region whose principal industries, agriculture and grazing, are both so dependent for their future development upon a cheap and accessible timber supply.

(*d*) To the west of the Plains region lies the ***Rocky Mountain Forest,*** occupying more or less isolated mountain chains or mountain masses separated by grazing lands, deserts, or cultivable valleys. The Rocky Mountain Forest has its eastern extensions far in the heart of the Plains country, as in the case of the Black Hills Forest in North Dakota. Its predominant characteristic at middle and lower elevations is semi-aridity, and its distribution is limited by a combination of forest fires and deficient rainfall. Its principal timber trees are the western yellow pine (*Pinus ponderosa*, Laws.), the Engelmann spruce (*Picea engelmanni*, Engel.), the red fir (*Pseudotsuga taxifolia*, Lam., Brit.), and the lodgepole pine (*Pinus murrayana*, "Oreg. com.") The principal products of the Rocky Mountain Forest are water, wood, and grass, in the order named. The chief industry of this region is, or is about to become, irrigated agriculture. Since the passage of the National Reclamation Act of 1902, which provides for the reclamation of vast areas of irrigable arid land under the auspices of the Federal government, the watersheds of the region have taken first place in its economic resources, for here water, not land, is the measure of value of the farm. All the industries of this region hang with peculiar dependence upon the forest. The distance from which supplies of timber for mining, for railroads, and for domestic purposes must come if the Rocky Mountain forests are once exhausted makes their preservation an imperative necessity on these accounts, while the existence of summer range in the forest for herds of cattle, sheep, and horses gives value to immense areas of winter range which without it would be of little use, and thus maintains one of the most important industries of the region. Because of the aridity of the country the forests of the Rock Mountain region are destroyed with peculiar facility by fire, by overgrazing, and by overcutting. The reproduction is less rapid and abundant than on either the eastern or western coast, while the preservation of the forest, of vast importance everywhere throughout the United States, is here more peculiarly and immediately essential to the well-being of the people than is the case elsewhere.

(*e*) West of the Rocky Mountain Forest stretches the *Pacific Coast Forest,* probably the most densely timbered and prolific forest region of the earth. In California the forest of the Sierras, characterized by the big tree (*Sequoia gigantea*, Decaisne), the sugar pine (*Pinus lambertiana*, Dougl.), and numerous magnificent firs, is perhaps the most beautiful and attractive in existence, while the forest of coast redwood (*Sequoia sempervirens*, Lamb., Endl.) has a larger stand of merchantable timber per acre than any similar area of which we have knowledge. In Oregon and Washington, the red fir (*Pseudotsuga taxifolia*, Lam., Brit.), the coast cedar (*Thuya gigantea*, Nutt.), and the tideland spruce (*Picea sitchensis*, Bong., Trautv. and Mayer) are lumber trees of the highest commercial value and the chief economic components of the forest, while the coast hemlock (*Tsuga mertensiana*), for the present less sought after than the fir, and the red fir itself alternate as the most numerous tree in the forest. Water is the most important product of the Sierra forest, wood of the redwood belt and of the coast forests of Washington and Oregon. The cut of redwood in 1900 was 360,000,000 feet, the lumber product of Oregon 740,000,000 feet, and that of Washington 2,300,000,000 feet. During the year 1902 the loss from fire in the State of Washington was said to be about twice the cut. Although it is true that wood is by far the most important product of the coast forests of Washington and Oregon, yet the prevention of floods from the heavy rainfall and snowfall of the coast is of critical importance to many agricultural valleys.

Forests of the Philippine Islands.— The forest lands of the Philippine Islands cover an area which certainly exceeds 40,000,000 acres. They are rich both in the number and in the value of their species, and their total stand of merchantable timber is exceedingly large. Except for occasional private or monastic holdings, they are entirely in the possession of the United States, and are being administered by an Insular Bureau of Forestry in competent and reliable hands. The development of practical and systematic forestry in the Philippines is likely to be even more rapid than in the United States, and the returns from the government forests there, already more than double the expense of administration, will form one of the most important sources of revenue from the islands.

Forest Protection.— The early settlers in New England and Pennsylvania, coming as they did from regions where forest protection was rigidly enforced for the sake of the game, brought with them the survival of their habits at home, and made provision among their earlier laws for the preservation of the forest. This transplanted care for the woodlands did not long survive either in legislative or in effective public desire. It was succeeded by a reasonable appreciation that the forest, in the early days on the Atlantic Coast, was the enemy of the settler. The state of mind which was thus produced survived in enmity to the forest long after the progress of civilization had converted it from an enemy of the settler to his best friend, and the eagerness for forest destruction which has characterized the great majority of frontier com-

munities in the United States has, after the early days, had no more legitimate cause. Until the immense expansion of the railroads which followed the close of the Civil War, the demand for timber was comparatively local in character, and the great operations of destructive lumbering had not begun. Since that time forest destruction has increased progressively until the exhaustion of the timber supply has almost been accomplished in certain regions and is imminently threatening elsewhere. Even before the era of gigantic lumbering operations, organized bodies began to take action for the preservation of the forest, but it was not until the resolutions of the American Association for the Advancement of Science in 1873 that such action achieved results. These resolutions called upon the National government to investigate the forest situation of the United States and to move accordingly. In 1876 the Commissioner of Agriculture, through Dr. Franklin B. Hough, one of the most honored pioneers of forestry in this country, organized such an inquiry. The work which Dr. Hough then began developed into the Division of Forestry in the United States Department of Agriculture, which division was greatly enlarged and became the Bureau of Forestry in 1901.

The Bureau of Forestry.— The Bureau of Forestry is divided into six offices. The Office of Forest Management prepares working plans for conservative lumbering for the National forest reserves (see below) and for State and private forest holdings. Its practical assistance to the owners of timberlands is given on the ground, either without cost in the case of small areas, or at the cost to the owner of expenses only in the case of larger tracts. The area of private forest land for which applications for assistance had been made on 1 July 1903 was 5,656,171 acres, an area far larger than the force of the Office of Forest Management has been able to cover. The total area of private lands put under management at the same date was 679,194 acres. The Office of Forest Extension gives assistance in tree planting under conditions similar to those described for the Office of Forest Management, studies methods of re-establishing the forest on areas which it once occupied, and gives special attention to the study and prevention of forest fires. On 1 July 1903 the area for which planting plans had been made amounted to 10,807.47 acres. The Office of Forest Measurements calculates, drafts, and puts into final form the very extensive measurements and maps made in the field by the Offices of Forest Management and Forest Extension. The Office of Forest Products studies the uses of timber and other forest products, makes timber tests and chemical examinations of by-products of the forest, and gives special attention to the preservation of wood. The Office of Dendrology deals with the natural history and nomenclature of trees and forests, and has charge of the forest library and the collection of forest photographs of the United States. The Office of Records is charged with the routine and the business operations of the Bureau. The appropriation of the Bureau of Forestry for the year ending 30 June 1904 was $350,000. It will be evident from what has been said that the work of the Bureau is to forward both the study of the forests of the United States and the application of practical forestry upon them regardless of the character of their ownership.

National Forest Reserves.— Parallel with the development of the Bureau of Forestry, two other lines of National forest work have sprung up, one in the General Land Office, the other in the United States Geological Survey. To the General Land Office the custody and disposal of the lands of the public domain have been given, together with the care and management of the National forest reserves created from time to time by proclamation of the President of the United States under the Act of 3 March 1891. These reserves, situated in all the Western States and Territories except Nevada, occupied on 1 July 1903 an area of 62,343,645 acres. When the first reserves were created, it was natural that their administration should be placed in the hands of the Land Office, which had had charge of these lands before they were reserved, but the development of the other government forest work has made it evident that a change is required.

In 1895 the president of the National Academy of Sciences was requested by the secretary of the interior to appoint a committee to examine the forest lands of the public domain and report a policy for their management. Upon the recommendation of this committee, President Cleveland, on 22 Feb. 1897 created some 22,000,000 acres of forest reserves. The proclamation of these reserves was immediately followed by protests in the Western States and Territories so vigorous that Congress suspended the operation of the President's proclamation for a year in all the States affected except California, whose senators, recognizing the value of reserves to their State, protested against the suspension. At the expiration of the year of suspension the proclamation of President Cleveland became effective in spite of some opposition in the West, and the forest policy of the government has never been seriously threatened since that time. The law of 3 June 1897 conferred upon the secretary of the interior all necessary powers for the management of the forest reserves through the General Land Office, and gave to the director of the Geological Survey, who had been instrumental both in saving the reserves from permanent suspension and in procuring the passage of the law, certain duties in connection with them.. He was charged with the survey and description of the reserves, with mapping their topography and timber, and with recommending to the secretary of the interior their proper boundaries and marking them permanently upon the ground. The duplication of work and the loss of energy involved in the dispersion of the National forest work under these three independent agencies has been called to the attention of the Congress by the President of the United States and is likely soon to come to an end.

State Forestry.— While the national government was making the progress described, various States were taking active measures in forestry. Among those Minnesota and Pennsylvania are conspicuous for the excellence of their fire laws, New York and Pennsylvania for their forest reserves, Michigan, California, and a few other States for peculiar excellencies of State organization or public sentiment on the forest question, but except in some of the States already named

and a few others the state movements for forest protection have not usually been notable either for efficiency or good results.

Forest Schools.— Instruction in forestry began in this country under the mistaken impression that forestry differs but little from horticulture and botany. But the character of forest teaching has been revolutionized within the last few years, and at present opportunity for education in professional forestry is not wanting in the United States. One of the earliest practical courses of forestry, discontinued shortly after it began, was given in the State University at Bozeman, Montana, under Capt. George P. Ahern, U. S. A., now in charge of the Bureau of Forestry in the Philippine Islands, but the first effort toward the establishment of professional instruction was in the simultaneous opening in the autumn of 1898 of the Biltmore Forest School at Biltmore, North Carolina, and the New York State College of Forestry as a part of Cornell University. The former offered a one year course without entrance examination and is still continuing to do so. The Cornell School, which offered a four year undergraduate training in professional forestry and had begun to graduate students capable of passing the government examinations, was discontinued in 1903. The Yale Forest School, which offers a two year post graduate course to the holders of a bachelor's degree from any recognized institution of learning, was established in 1900. It has already graduated more professional foresters than all other schools combined. The University of Michigan has just instituted a two year post graduate course, the University of Nebraska has established a four year undergraduate course, the State Agricultural College of Minnesota has established a four year course; Harvard University offers some instruction in forestry in the Lawrence Scientific School, and many other institutions afford the opportunity for more or less complete and effective training in various branches of forestry.

American Forestry Association.— The American Forestry Association, organized in 1882 as the American Forestry Congress, has been one of the most effective agencies in the progress of forestry and forest preservation in the United States. Its influence upon legislation has of late years been a notable one, and its summer meetings, held in whatever portion of the country needs its influence most, have been exceedingly effective in educating public opinion. Its official organ, formerly 'The Forester,' now called 'Forestry and Irrigation' because it has become likewise the organ of the National Irrigation Association, is the best forest periodical in the United States and one of the best in existence. In the publicity which it gives to forestry, it has been of late most cordially and helpfully joined by the lumber journals and the daily press of the country. The newspaper press as a whole has been a most effective agent in the dissemination of right ideas of forestry and in bringing about in Congress, among lumbermen, and among the people at large the strong support of practical forestry which is now perhaps the most hopeful sign of the forest situation in the United States.

The Practice of Forestry.— The practice of forestry in the United States naturally falls under two heads: First, those forms of conservative lumbering which were practised by farmers, lumbermen, and others without the assistance of professional foresters. Second, those forms of conservative lumbering which have been introduced under the supervision of the latter. In both cases a factor of the utmost importance is found in the methods of logging adopted or devised by the American lumbermen in different parts of the country.

Destructive Lumbering.— The methods of felling timber, except for variations in the forms of axe and saw, are approximately similar throughout the world, but the methods of handling the felled timber vary greatly. In the United States the mechanical and inventive capacity of the people has led them to develop forms of logging cheaper and more effective than those in use elsewhere. These methods have become highly specialized in response to the requirements of the market, the topography, and the forest itself in the different forest regions. In the Northern Pine Forest the final operations of logging await the fall of sufficient snow to make possible the preparation of solid ice roads over which the logs can be hauled to the bank of a stream or to the railroad. In the Southern Pine Forest and throughout the larger part of the interior hardwood region snow is not a factor in the logging. Its place is taken to some degree by timber slides or by installations of wire rope cables which drag or carry the logs from the stump to a logging train. In the Rocky Mountain region the methods vary greatly, but on the whole they are less highly developed there than in the denser timber on the Pacific slope, where wire rope logging has reached a very high point of economy and efficiency. Here the logs are dragged over specially prepared skid roads by wire cables of great length attached to the drums of donkey engines, which transport themselves about the woods by their own power whenever change of location is required. Forestry being in many respects more closely akin to lumbering than to any other occupation, it is of first importance to the forester that effective and economic methods of logging should be employed. These methods hitherto have been wasteful and destructive both to an unnecessary and to an unprofitable degree, and the future of the forest has been needlessly sacrificed to the idea of immediate gain. Conservative lumbering harvests the present forest crop economically and profitably at the same time that it provides for future growth.

Forestry by Private Owners.— The idea of perpetuating the forest by wise use, which is the essence of forestry, had found hospitable lodgment in the minds of many Americans before forestry had become a recognized profession in the United States. Examples of the treatment of the forest from this point of view were more common in the northern spruce forests than elsewhere, and especially on the Androscoggin River in Maine, where great permanent value was given to very considerable tracts of spruce land by careful handling. Among the farmers of New England, New York, and New Jersey the harvesting of successive crops of hardwood sprouts for fuel, fencing, etc., was a common practice during the last century, but as a rule the methods used, like those for the spruce in Maine, were less effective than they might easily have been.

FORESTRY IN THE UNITED STATES

Beginnings of Professional Forestry.— In 1891 the first example of professional forest management in the United States was begun on the Biltmore estate near Asheville, North Carolina, in a mixed forest of hardwood and pines which had been severely damaged by the mismanagement of former owners. The object of the management was to secure what revenue was possible from the forest while conducting such operations as were required to put it in good condition. Even in the first year the forest work paid for itself, and it has been conducted successfully ever since. No further examples of professional forest management were created until, in the summer of 1898, practical forestry was introduced, under the care of the then Division of Forestry of the Department of Agriculture, on two tracts in the Adirondacks of a total area of more than 100,000 acres. Other instructive examples of co-operation in practical forestry between private owners and the government have been created in Maine, Tennessee, Georgia, Texas, and many other States and Territories, and the plan is still in increasingly effective operation. Under it the great majority of the conservative forest management now in existence in the United States has been brought about. The types of practical forestry which have been adopted or devised for application in these various cases include improvement cuttings of various degrees of refinement, several types of treatment of sprout lands, and a variety of forms of the high forest and selection systems, the most typically American of which is what is called localized selection. In all cases their application has been reduced to the utmost simplicity, and a definite effort has been made to limit interference with the ordinary methods of logging to the smallest possible amount. As a result they have not interfered as a rule with the profits of the forest, while the reproduction and perpetuation of the forest, the other principal object of the management, has been fully secured. Through the application of these simple and effective methods forms of forest management peculiarly adapted to American conditions are growing up. In the early practice of American foresters many of the important tenets of European forestry, such as the doctrine of the sustained annual yield, have wisely and necessarily been abandoned, and effort has been confined to insuring the profitable use of the forest and its continuance in productive condition, not seldom at the expense of a long hiatus in the yield, provided such a form of management was satisfactory to the owner. The conditions of the lumber trade here justify the transportation of forest products for longer distances than is possible in Europe, and localities are far less dependent in America upon the local supply than is the case abroad. A fundamental consideration in determining forms of management in the United States is the extremely moderate price of low grade forest products such as firewood and the cheaper kinds of lumber. This fact, together with the cost of transportation, decides what kinds and grades of timber can be profitably cut and how closely what is cut can be put to use. Logging under the conditions of which not more than 50 per cent of the growing tree ever reaches the market, is still practised in several parts of the United States. The duty of perpetuating the forest is not less imperative under such conditions than where the price of lumber is higher. The methods of the American forester, although they must be the product of ripe training and experience if they are to succeed, are often summary and rough. In every case they must pay and in every case they must insure the perpetuity of the forest. If they succeed in these two essentials, their roughness may be disregarded.

Principal Forest Problems.— The efforts of American foresters are at the present time largely grouped about a few principal forest problems which arise from the nature of the forest, from the dangers which threaten it, and from the economic conditions by which it is surrounded.

The National Forest Reserves.— Since it is the general experience of all countries that the only forests which are permanently safe are those in the hands of a permanent owner, namely the government, the United States has by the creation of forest reserves undertaken to set aside and hold in the public hands those areas within the public domain whose preservation is essential to the public welfare. The establishment of these forest reserves met at the beginning, and in certain instances continues still to meet, unthinking opposition in certain parts of the Western States where lie the 863,000,000 acres which remain of the public lands. But in each State public sentiment is crystallizing rapidly and effectively in favor of forest preservation. This trend of the public mind makes it continually easier for the national government to set aside and hold those forest lands which it should retain, and is rapidly making possible a better administration of the reserves themselves. The latter are located either at the headwaters of streams whose protection is essential to irrigated agriculture on the lands below them, or in more densely forested regions where the preservation of the timber supply is the first consideration. In either case their preservation alone can meet a critical public need. It is unfortunate that the personnel of forest supervisors and forest rangers available for their protection has remained far below their requirements. The natural result has been that the diminution of forest fires, although striking in amount, has been less than might have been accomplished, while the stock ranges have continued to suffer from overgrazing and the reserves have been injured to some extent by timber stealing and by minor depredations. They have nevertheless answered a most important and beneficent public purpose, and under the policy which controls their administration their value to the people will steadily increase. This policy briefly stated is the employment of all their resources for the good of the people, and thus, in the language of President Roosevelt, the making and maintaining of prosperous homes.

Forest Fires.— It is altogether probable that more timber has been destroyed in the United States since the landing of the Pilgrims by fire than by the axe. In every country where timber is plenty and settlers few, fire has been harmfully employed to assist the settler in his warfare against the forest. With the progress of civilization railroads have scattered along their rights of way fires which have destroyed thousands of square miles of timber. The transcontinental railroads are lined for hundreds of miles, where they traverse the forest regions, with the bleached fire-killed remnants of the

former stand. Prospectors often set fires in heavily timbered countries to uncover the surface of the mineral soil, and campers, hunters, and others, either by the injudicious location of their fires or by neglect in leaving them unextinguished, have been responsible for much important loss. The use of steam machinery in logging and the supposed necessity for burning away the debris, as in the case of the coast redwood of California before skidding the logs, has been responsible for many fires. The loss from forest fires is confined to no section of the country and its percentage has diminished but little of late years, if at all, in proportion to the total stand of timber which remains. Although exact figures are not obtainable, it probably exceeds on the average a total of $50,000,000 a year. The Hinckley fire of 1894 in Minnesota destroyed property valued at $25,000,000 and cost the lives of 418 persons. For two weeks before the high wind which gave it its destructive power this fire was smoldering in the neighborhood of Hinckley and could have been extinguished easily and cheaply at any time. During the autumn of 1902 fires destroyed property valued at $13,000,000 in the States of Washington and Oregon, while in the spring of 1903 about 650,000 acres were burned over in the Adirondack Forest in New York. Such losses are as unnecessary as they are appalling, for a small fraction of the cost of these fires expended in preventive measures would have rendered their occurrence practically impossible. There is but one effective safeguard against fire in the woods, an enlightened public sentiment with regard to it. Such a sentiment is rapidly being created within and near the National forest reserves and in certain other portions of the country. While the effort to produce it is in progress the National Bureau of Forestry is studying the natural history of forest fires and devising the cheapest and most effective means for extinguishing them. It is studying likewise their effect upon the condition and production of the forest, and the amount of loss, as special means of awakening public opinion. In the dense and moist forests of the northern pine belt, forest fires of importance almost invariably originate in the debris of cut-over lands and not seldom are unable to penetrate the untouched virgin forest. In unusually dry seasons, however, fires may burn throughout any woodlands without distinction, and it is in such seasons that conflagrations like the Hinckley and the Peshtigo fires take place. Except under extraordinary conditions, fires in forests of this type are apt to move slowly, but they are difficult to extinguish because of the mass of inflammable material in the forest floor. Mature trees in the Interior Hardwood Forest and the Southern Pine Forest are seldom killed by fire if the bark is unbroken and sound. Fires in these regions usually travel along the ground with moderate speed and are seldom dangerous to human life. The damage they occasion is in the destruction of young growth and the unsoundness which they produce in trees of larger size. They are especially destructive in those portions of the Southern Pine Forest where the longleaf pine is boxed for the production of naval stores. Where a boxed tree catches fire it is lost for such production, and most often succumbs to the attack. In the Rocky Mountain Forest fires are less uniform in type. Where the timber is dense, and especially where it is composed of a thin-barked species such as the lodgepole pine, not infrequently vast areas of the forest are killed by a single fire. In such cases the trees are not consumed, but stand bleaching long after they have lost their bark, and finally fall in an almost impassable tangle of prostrate trunks, to be consumed later by another fire together with the young growth which has sprung up among them. In the more open forests of the western yellow pine, the damage is to the young growth and to the soundness of the old trees. In many regions it is practically impossible to find a tree of any size that does not bear the marks of fire. The most serious effect of fires in the coast redwood of California is to prevent the sprouting of the old stumps after logging, and thus to convert highly valuable timberland into indifferent pasture. In the fir forests of Oregon and Washington fires are common and difficult to extinguish, but usually slow-burning and not of great extent. It is only in seasons of exceptional dryness that losses of appalling magnitude are to be expected. The State of Washington has recently passed a forest fire law, the operation of which will be watched with peculiar interest.

Some Uses of Wood.— The yearly product of wood in the United States is about 35,000,000,000 feet. In 1900 the lumber industry employed 283,260 wage-earners, to whom it paid $104,640,591. The perpetuation of this industry is of vital concern to all the people. Its ramifications are as wide as the industrial life of the nation, and its perpetuation is a most pressing concern of the forester. The use of wood for the maintenance of railroad tracks, for example, rises to about 120,000,000 ties a year, together with vast amounts of bridge timber, piling, etc. Since the use of metal ties is believed to be impracticable by American railroad engineers, the maintenance of the supply of wooden ties is of vital importance to the railroads, and through them to the nation at large. In a similar way, the permanence and success of the mining industry is dependent upon cheap and accessible supplies of timber. In most portions of the West such supplies can be expected only from the national forest reserves. In the creation of the reserves, therefore, the special needs of mining and other industries have been kept carefully, and it is also believed successfully, in mind.

Summary.— The profession of forestry, which has already reached high standing on the continent of Europe, in British India, and elsewhere, is being born in the United States. Its establishment on a high plane is of the first importance to the solution of every problem of American forestry. The forest wealth of this country, although vastly diminished, is still very great, and the reproductive capacities of its forest are usually of the first grade. Wood is cheap and methods of the lumberman are wasteful. The low cost of transportation permits the movement of forest products from vast distances, so that local markets are supplied from distant points. In view of all these conditions, the task of the American forester is to secure the reproduction of the forest without materially impairing the profit of lumbering, and wherever possible to bring into public ownership whatever forest lands are required to supply in permanence the public need. GIFFORD PINCHOT,

Bureau of Forestry, Washington.

Forests, Petrified, fossil remains of forest trees and plants found in the Potsdam sandstone formations in America and the Cambrian rocks of Europe. Large forest trees, fossilized and converted into stone are found in many sections of the United States, particularly west of the Mississippi River. Those of Arizona are well known. PALÆOBOTANY.

Forey, Elie Frédéric, ā-lē frā-dā-rik fō-rā, French military officer · b. Paris, France, 10 Jan. 1804; d. there 20 June 1872. He took part in several Algerian campaigns as well as in the Crimean and Sardinian wars, and when the expedition to Mexico was decided upon in 1861, Forey received the command of the French troops. After several sanguinary engagements, he attacked and stormed the strong post of Puebla, thereby throwing open the road to the city of Mexico. For this service he was made marshal of France.

Forfeiture, fôr'fit-ūre, a legal penalty, by which an owner is absolutely deprived of his property for crime or other unlawful act. This applies to personal as well as real property, and forfeiture may be a decree of civil as well as criminal courts. The penalty is of feudal origin. The lord owed protection to the life and property of the vassal; the latter owed fealty and service to his lord. When the vassal failed to yield these, he lost the shelter of the law, became an outlaw, and incapable of holding property. Loyalty to the feudal relation being the condition on which life and property were secured to him, when he failed in loyalty he had no longer any claim on life or property.

Treason was punished by forfeiture long before the Norman Conquest in 1066. After that period forfeiture became the ordinary penalty for felony, which was styled petty treason; while treason, or disloyalty in regard to the sovereign, was called high treason. Forfeiture was accompanied by what was styled corruption of blood. This was the sentence of legal bastardy passed on the offender so that he could neither inherit nor bequeath property.

Felony in the United States has never been considered ground for forfeiture. The Federal and State laws have modified all precedents in the matter of forfeiture, which they restrict within very narrow limitations. See ATTAINDER.

In England civil forfeiture may be incurred by tortious alienation, by wrongful disclaimer, by alienation in mortmain (see MORTMAIN), by breach of condition, and by the commission of waste (see WASTE). In Scotland civil forfeiture may arise either from statutory enactment, at common law, or by agreement. In the United States civil forfeiture is only imposed for acts of waste committed by tenants for life or years, or for breach of contract in violating the conditions on which lands were granted. Some States have abolished even this degree of forfeiture. By particular statutes enacted by Congress smuggling, or importing goods on fraudulent invoices involve confiscation, and forfeiture of the entire invoice (see INVOICE), or the balance wrongly imported. Piracy has always entailed confiscat'on or forfeiture of the piratical craft.

Forge, Forging, and **Forging Machines.** A forge is a furnace or open fireplace, having a forced draft, for heating metals, especially iron and steel, to be shaped by hammering or pressure. Previous to the 19th century, most iron work was forged by smiths on avils. Then came the period of cast iron, when everything that could be cast was made that way because it was cheaper, and during the last half of the century the use of forged iron and steel increased enormously owing to improved and cheapened methods of production. Now, in 1893, a vast quantity of steel for machine-made forgings finds its way into machines and structures, giving greatly increased strength and durability. A simple blacksmith's forge is a brick structure, with a chimney at one side. The coals and fire are located at the mouth of the chimney, and a bellows or rotary fan furnishes a blast of air which is driven from underneath through the mass of coal. This coal is usually soft, sometimes being termed blacksmith's coal. Portable forges are made for light work, and a common form of these has four legs made of iron tubing, a shallow bowl to hold the coal and contain the fire, and a hood above. At the rear is a small rotary fan; operable by a wheel-crank. As forges increase in size and capacity, they develop into what are more properly called furnaces, such as the immense heating furnace of a steel works. In forging iron by hand the smith thrusts the metal into the centre of his fire, and its color tells him when it is ready to be worked. As it heats, it becomes black red, then a low red, then bright red, then a white heat, and if the heating continues it next begins to burn. If the smith desires the iron to be very soft, that it may yield quickly to his blows, he lets it come to a white heat, then takes it with his tongs on to his anvil, and begins to hammer it rapidly into the desired shape. Often a helper stands by to strike blows alternately with the smith, in order that as much hammering as possible may be done before the iron cools to a point where it requires reheating. Long practice makes very expert smiths, and many of them will shape a bar of iron into intricate form in a surprisingly short space of time. When the smith desires to weld together two pieces of iron, he must heat both pieces at the same time to a uniform white heat. As the iron approaches a white heat he throws sand on it, which, if done at the proper temperature, adheres and melts, forming a liquid glass-like fluid that flows over the surface of the iron and keeps the air from it, thus preventing its burning. If the ends of two bars are to be welded, each is first brought to a flat point, so that there will be considerable surface to weld together. After the surfaces adhere, the weld may be reduced by reheating and hammering down to the size of the other portions of the bars. When pieces are joined end to end, this is termed a butt-weld, which is not apt to be as strong as a lap-weld. Where forgings are so large that a smith and helper cannot work them satisfactorily, because there is too much and too heavy hammering to be accomplished in the short time the metal retains its great heat, the machine hammer is resorted to. This was made in various forms, and was an important tool during the early part of the 19th century, finding its culmination in the great steam-hammer of Neysmith, which was devised especially for such large forgings as the shafts of paddle-wheel steamships, then coming into use. The trip-hammer and the steam-hammer were the chief tools used for large forgings until about 1890

when the hydraulic press began to supersede the hammer for large work. About 1884, when the United States government began to seriously take up the rebuilding of the navy, and the construction of steel battleships and cruisers, there came a demand to American manufacturers for very large forgings, which had not previously been produced here. The forges of that date were equipped with power hammers, of a capacity suited to welding wrought iron into forgings of moderate size. The introduction of steel rails taught American iron manufacturers that steel forgings were desirable in all classes of machinery, as greatly reducing the size of the parts, because of the increased strength.

The hydraulic compression system of forging, which was introduced in America when our steel plants were called upon to provide the large forgings for the navy, has met with general approval, and is steadily increasing in use. It has been demonstrated that forgings made by hammering were subject to all sorts of internal strains due to differences in compression and differences in cooling. When such a forging is cut, as for making a keyseat, a distortion of form follows as the result of certain strains that have been relieved. A large forging requires a pressure great enough to penetrate to every part of the mass of metal, so that the flow of metal resulting shall take place uniformly throughout. Such a flow requires time and a pressure that can not be obtained by a quick hammer blow, and a series of blows does not produce the same effect as does the persistent pressure of the hydraulic forging machine. Fluid steel begins to crystallize at the point where the degree of heat is reduced so that it solidifies (about 2,600° F.), and the more slowly it is cooled from this point downward, the larger will be the crystals of the ingot. Forging during the cooling tends to check crystallization, just as stirring water at a temperature below the freezing point would check the formation of ice crystals. The more irregular the method of forging is, as in the case of hammer blows, the more it interferes with an even crystallization. The pressure system not only interferes much less than hammering, but forgings are farther improved in modern practice, by reheating above the recalescent point, which is between 1,200 and 1,300° F., depending on the percentage of carbon and annealing to secure a new crystallization, and oil tempering.

An examination of the grain or fibre of hydraulic forgings shows that the steel tends to arrange itself in layers following the outer contour of the piece of metal, thus securing the most strength. A sharp angle in the pattern will tend to cut off the flow of metal, and if such is required, the method is to round out the place in the forging, to secure the best flow of metal, and then machine off the surplus later.

To avoid internal strains as much as possible such large forgings as steamship shafts are preferably made hollow. That is to say, the cylindrical ingot from the furnace after cooling is bored through the centre, mounted on a steel mandrel, heated and forged by compression. Ingots produced with fluid compression are well adapted to being bored and hollow-forged, and this method produces the most perfect forgings. These large forgings are subjected to a hydraulic pressure of about 7,000 pounds to the square inch, which pressure is maintained while the mass slowly cools. Shafts of more than a foot diameter are best bored, as the bore hole not only assists uniform heating, but gives opportunity for inspection.

Small forgings of iron, steel and other metals are now most commonly produced by the method known as drop-forging. A press containing a top and bottom pattern (die and counter) receives the roughly shaped hot metal, and at a single blow brings it to the desired shape. Parts of machines that were formerly made of cast iron or steel are now drop-forged at moderate cost, and the metal is so much stronger that they can be lightened materially in weight, thus sometimes actually reducing the cost, while increasing the durability. See BELLOWS; FURNACE; HAMMER; IRON; PRESS; STEEL; WELDING.

CHARLES H. COCHRANE.

Forgery, the fraudulent making or alteration of a writing to the prejudice of another man's rights, or making of any written instrument for the purpose of fraud and deceit; the word *making*, in this last definition, being considered as including every alteration of or addition to a true instrument. The offense of forgery may be complete though there be no publication or uttering of the forged instrument; for the very making with a fraudulent intention, and without lawful authority, of any instrument which, at common law or by statute, is the subject of forgery, is of itself a sufficient completion of the offense before publication. Most of the statutes, however, which relate to forgery make the publication of the forged instrument, with knowledge of the fact, a substantive offense. A deed forged in the name of a person who never had existence is forgery at law. A writing is forged when a person drawing up a will for an invalid, inserts legacies therein falsely. It is not material whether a forged instrument be drawn in such manner that if it were in truth that which it counterfeits it would be valid. The punishment of forgery at common law is, as for a misdemeanor, by fine, imprisonment, and such other corporeal punishment as the court in its discretion might award. The penalty varies in different States, in some the statutes having been much enlarged to include acts which were not punishable formerly as forgery. The punishments ordained for the offense by the statute law in England were once, with scarcely an exception, capital.

Forli, Melozzo da, mā lōts'ō dä fōr lē', Italian painter: b. Forli, about 1438; d. 1494. He was the first who applied the art of foreshortening to the paintings of vaulted ceilings About 1472 he painted the 'Ascension' in the great chapel of the Santi Apostoli at Rome for Cardinal Riavio. In 1711, when the chapel was being rebuilt, this painting was cut out of the ceiling and placed in the Quirinal palace, where it still remains.

Form, in philosophy, a term used (1) objectively, to denote the assemblage of qualities which makes a thing what it is. Only the essential and permanent is considered, the accidental or adventitious being disregarded. The word is employed also (2) subjectively, to express the idea which the mind may supply of an object, as distinguished from that object as it is in itself. In this sense it is peculiar to the philosophy of Kant, who postulated two such ideas, namely space and time, supplied to the

object by the mind through the operation of experience.

In botany, the term used to designate the unit of ecology, as that division of the study which treats of the relations existing between plants and their environments is now called. The word is frequently met with in such combinations as "form of vegetation" or "plant form." See BIONOMICS; PLANT GEOGRAPHY.

In music, that theory in the general art of composition in accordance with which themes, tonalities, phrases, and sections are so arranged as to obtain a correlated and symmetrical whole. The principal three recognized forms are those of the *lied*, *rondo*, and *sonata*. These admit of numerous variations. In so-called cyclical forms, as, for example, the symphony, the necessary correlation and symmetry is secured by the relation of the movements as to proportion and key, the succession of various tempi, and sometimes also the employment in one movement of a theme previously used in another.

Formâ Pauperis, fôr'ma pâ'pėr-is, **In,** signifying — in the character of a poor person — is the legal term both in Great Britain and the United States for suits carried on by individuals who are too poor to pay the usual fees. As early as the reign of Henry VII., a statute provided that any one taking oath that he was not worth £5 beyond his wearing-apparel and the subject in dispute, was entitled to have writs, according to the nature of the case, without paying fees, and the judges were to assign him counsel and attorney who should act gratuitously. This indulgence is granted to plaintiffs only at common law, and is granted to defendants only in prosecutions. A plaintiff must have a counsel's certificate of a good cause of action, and an affidavit of the party or his attorney must be laid before court that the case contains a full and true statement of material facts. A person admitted to sue *in formâ pauperis* is not entitled to costs from the opposite party, unless by order of the court or of a judge. In several of the United States the provision is governed by statute, while in others it is considered part of the common law.

Formaldehyde. See BACTERICIDE; DISINFECTANTS; FUMIGATION.

Form'alin, a solution produced by dissolving in 60 per cent of water 40 per cent of what is known as formaldehyde gas, CH_2O. This solution has hitherto been looked upon as a powerful disinfectant. Dr. Charles C. Barrows has recently employed formalin as a specific for sepsis or blood poisoning. The patient was a colored woman, 26 years of age, who was on the point of death; the virulent bacteria of septicæmia, streptococci, had been recognized in her blood, her pulse ranged from 150 to 160 and her temperature was 108. Into one of the large veins of the right arm an attempt was made to inject one litre of formalin solution of the strength of one part of formalin to one thousand parts of water. About 500 cubic centimetres of the solution found its way into the circulation. The temperature fell almost immediately and the pulse showed an instantaneous improvement. The day after another injection was made and examination showed that bacteria were no longer present in the blood. A third injection into the patient's left arm introduced 750 cubic centimetres into the circulation. The temperature fell to normal, no more bacteria were developed and the woman recovered rapidly.

For'man, Harry Buxton, English author: b. London 1842. He entered the Civil Service in 1860 and is an assistant general secretary at the General Post-office, London. Besides editing the poems of Shelley (1876–80), of Keats (1883) and other works, he has published: 'Our Living Poets' (1871); 'Elizabeth Barrett Browning and Her Scarcer Books' (1896); 'The Books of William Morris' (1897).

Formation, in geology, a term used of groups of rock, whether stratified or unstratified, having a similar origin or character. Thus it is usual to speak of a limestone, a sandstone, or a clay formation. The word has also been by some extended to be synonymous with system, or to denote a group of strata of the same age, as Canadian series, Carboniferous system, etc.

Formen'to, Felix, American surgeon: b. New Orleans, La., 16 March 1837. He studied at Jefferson College, Louisiana, and the University of Turin, Italy, and was a surgeon in the Franco-Sardinian army during 1859, and in the American Civil War was chief surgeon of the Louisiana Confederate hospital at Richmond, Va. At one time he was president of the American Public Health Association, later president of the Confederation of State and Provincial Boards of Health of North America, and in 1898 was appointed surgeon to the Louisiana Soldiers' Home. His publications include monographs on cremation, military surgery, alcoholics, and other professional subjects.

For'mes, Karl Joseph, German-American operatic basso: b. Mülheim-on-the-Rhine, Germany, 1810; d. San Francisco, Cal., 1889. He made his first appearance at Cologne in 1841 as Sarastro in Mozart's 'Flauto Magico.' He quickly obtained an European reputation, and after connection in 1852–7 with the London Royal Italian Opera, came to the United States, where he was received with much approval and remained during the greater part of his life.

For'mic Acid, a monobasic organic acid having the formula CH_2O_2, or H.COOH, the final H in the last of these formulæ being the one that is replaced when the acid combines with bases to form its salts (which are known as "formates"). It is an important substance in organic chemistry, and may be obtained by the oxidation of methyl alcohol, as well as of starch, sugar, and other organic substances. The most convenient method of preparing the acid is by heating anhydrous glycerin with crystallized oxalic acid. The reaction is not a simple one, monoformin being one of the intermediate products; but the obvious part of the reaction is that the oxalic acid is converted into formic acid with liberation of carbon dioxid. Pure anhydrous formic acid is a pungent, colorless liquid, boiling at about 212° F. at ordinary atmospheric pressure (its vapor burning with a bluish flame), and freezing at about 47° F. into a white crystalline mass. Formic acid is completely resolved by strong sulphuric acid into water and carbon monoxid, $H.COOH = H_2O + CO$. It reduces Fehling's solution (q.v.), and also reduces gold and platinum to the metallic state, from their solutions. When boiled with the nitrates of silver and mercury, formic acid precipitates these metals in the form of grayish metallic powders.

Formic acid and its salts are used to a certain extent as disinfectants and preservatives. The acid takes its name from the fact that it exists, in the free state, in the bodies of red ants (*Formica rufa*), from which it may be obtained by crushing the ants and distilling the mass with water.

Formica, fôr-mī'ka; **Formicidæ,** fôr-mĭs'ĭ-dē, the genus and family respectively which contain the typical ants. See ANT.

Formicariidæ, fôr"-mĭ-ka rī'ī-dē, a family of small, tropical American birds, the so-called «ant-birds.» They are numerous in genera and species, are related to the tree-creepers and plant-cutters, and frequent forests and thickets, flying badly from the shortness of their wings and consequently feeling most at home on the ground, where they devour beetles, spiders, and insect larvæ and berries, but are not known to eat ants at all. The nests are usually made in low bushes. They wear sober colors, as a rule, and the sexes are similar.

Formigé, Jean Camille, zhoṅ kä-mēl fōr-mē-zhā, French architect: b. Bouscat, Gironde, 1845. He was a pupil of Laisné, and received from the French government a commission for a series of plans for, and restorations of, public structures; the latter including the Roman theatre at Orange, Vaucluse. He executed decorations in the Paris Hôtel de Ville, became architect of Paris streets and parks in 1885, built the Liberal Arts and Fine Arts buildings at the Paris Exposition of 1889, and the buildings of the Rumanian government at that of 1900.

Forming Machines, a term has been applied generally to the lathe, planer, shaper, and all that class of tools used by the machinist to produce the parts of machines that he manufactures. It has also been used to designate presses used for drop-forging, and for shaping metal in the cold, particularly to drawing-presses that receive a sheet of metal, grip it between two surfaces and then subject a part of it to slow pressure until it is drawn out to a cup-shape or the like, if properly done without any wrinkling. A form of rope-twisting machine is also known as a forming machine as well as a machine for forming tin cans. See FORGING AND PRESS.

Formosa, fôr-mō'sä, called by the Chinese *Taiwan,* an island lying off the coast of the Chinese province of Fu-chien, from which it is separated by a strait from 90 to 220 miles wide. Formosa, which was ceded by China to Japan in 1895, is crossed by the meridian 121° E. and the tropic of Cancer, and has a maximum length of 235 miles, while its breadth varies from 70 to 90 miles; area, 14,978 square miles. Forming one link in the volcanic chain that extends from the Aleutian Islands southward to New Guinea, it constitutes the eastern escarpment of what was once the great Malayo-Chinese continent, and is connected by a submarine plateau with the Chinese mainland. The backbone of the island, extending north and south, is formed of a range of densely wooded mountains, called by the Chinese Chu-Shan, which rise to upward of 14,000 feet, the highest known peak, Mount Morrison, being given as 14,362 feet. Eastward of this range lies a narrow strip of mountainous country, presenting to the Pacific a precipitous cliff-wall with in many places a sheer descent of from 3,000 to 7,000 feet, while a very short distance farther east the floor of the ocean sinks to a great depth at an extremely steep gradient. The western side of the range consists of a single broad alluvial plain, stretching from north to south of the island, seamed by innumerable water channels, and terminating at the coast-line in mud flats and sand-banks. Yet on this side of the island the land is rapidly encroaching upon the sea, as the consequence of the gradual elevation of the western seaboard and the deposition in and around the embouchures of the rivers of the large amount of sediment brought down by them from the mountains. This latter process is primarily due to the heavy rainfall of the northern, central, and eastern portions of the island, where the rain-clouds of the northeast monsoon, after crossing the warm Kiosiwo, or Japanese Gulf Stream, on coming in contact with the mountain barrier of the island become chilled and discharge their contents in rains of excessive violence. Apart from this heavy rainfall, the climate is not exceptional, the insular position ensuring a modification of the heat by sea-breezes. The mean of summer is 80° to 90° F.; of winter, 50° to 60°. Malarial fever is, however, prevalent in the north, and violent typhoons are very common at certain seasons.

The island is famous for the luxuriance of its vegetation; many of the hothouse plants of warm temperate climes grow wild on the mountain slopes and in the valleys, such as orchids, azaleas, lilies, rhododendrons, and convolvulus; besides which there is a profusion of ferns, tree-ferns, camphor- and teak-trees, pines, firs, wild fig-trees, liquidambars, bananas, bamboos, palms, indigo and other dye plants, fibre and paper plants, oil and soap plants, tobacco, coffee, and tapioca. «Rice paper» is prepared from the pith of a tree peculiar to Formosa. Of animal life it is noticeable that there are at least 43 species of birds peculiar to the island, that insects are scarce and that noxious wild animals are few; but that fish is plentiful near the coast. The resemblance of the animals found on the island to those on the mainland is one reason for believing there was once a land connection. However there are a number of animals on the island which appear to be of quite a different species from those found in China. This is especially true of some of the birds, mice, squirrels, and deer. The chief minerals are coal, of which there is a large supply, gold, salt, petroleum, and sulphur. Agriculture is an important industry, but the people engaged in mining are becoming more numerous.

Since the treaty of Tien-tsin, in 1858, there have been ports open for foreign commerce; those opened in accordance with the conditions of the treaty are: An-ping, Tainan, Takow, and Tam-sui. An-ping and Tam-sui have the largest amount of commerce. The principal exports are camphor, tea, rice, sugar, jute, hemp, and dye-woods. The chief imports are a coarse cloth for clothing, opium, fruits, lumber, metal goods, and manufactured tobacco. The most of the trade is with Japan. Formosa controls the camphor markets of the world. The eastern slope of the mountains is covered with the largest camphor forest yet discovered. The amount of camphor exported each year from the forests of China and Japan is about 500,000 pounds; and from

Formosa alone there is shipped between 6,000,000 and 7,000,000 pounds. Since Formosa was annexed to Japan, the Japanese government has made most successful efforts to preserve the sources of supply of camphor. When the island belonged to China the camphor-trees killed to collect the gum were not replaced and the camphor forests were being destroyed. The Japanese government insists that for every tree destroyed another one must be planted; and it is also establishing camphor plantations, so that in future the Formosa cultivated camphor will be a commodity of commerce. The price of the camphor varies because of the dangers incurred in collecting it. Savage tribes which have never been subdued inhabit the camphor forests, and they never hesitate to attack the camphor gatherers unless the latter are well armed and in bands large enough to protect each other. The Japanese government has now a large armed force of policemen, over 1,400, to protect the camphor gatherers, and the cost of protection is added to the selling price of the gum. The sale of the camphor is a government monopoly; it is not difficult to obtain a permit to gather camphor, but every pound must be sold to the Japanese government, which determines the price. Japan limits the amount to be exported, and will not buy a pound in excess of the limit. The cultivation of the tea fields is receiving attention from Japan.

The inhabitants, estimated to number about 3,000,000, consist of Chinese settlers, some Japanese, and the aborigines. Respecting the ethnological origin of these latter there exists some doubt; they seem to consist of several different tribes, mainly of Malayan and Negrito descent. The Chinese distribute them into three classes, Pepohwan, a race of civilized and sinicized agriculturists; Sekhwan, settled tribes who acknowledge Chinese rule; and Chinhwan, the untamed savages of the mountains, who wage fierce and unceasing warfare against the Chinese immigrants. The administrative headquarters were formerly at Taiwan, but on the constitution of the island into an independent province of the Chinese empire in 1887 — it had formerly been incorporated with Fû-chien on the mainland — they were transferred to Tai-pei or Bangka. The island was known to the Chinese before the Christian era, but does not seem to have seriously attracted their attention until the year 605 or 606 A.D. In the 14th century they established several colonies in Formosa, which, however, were withdrawn in the middle of the 17th century. Although Portuguese and Spanish navigators began to visit the island a century earlier, the first European people to establish themselves on it were the Dutch, who in 1624 built Fort Zealandia, near the modern Taiwan. They were, however, expelled in 1661 by a Chinese adventurer, Koxinga, who retained possession of the island for 22 years. Some years later a regular Chinese colonization of the western half of the island was carried through, the colonists coming principally from Fû-chien and Kwang-tung. Subsequently the island became notorious for the piracy of its inhabitants and the ill-treatment they inflicted upon navigators who chanced to be wrecked on their coasts. Accordingly in 1874 the Japanese invaded Formosa; but on the Chinese undertaking to check the evils complained of they withdrew. Ten years later the French, during their contest with China in Tongking, held for a time the coal districts of Kelung. The occupation by the Japanese troops did not take place without opposition from the natives and Chinese "Black Flags," but the Japanese were practically in full possession of the island before the end of 1895, and set themselves at once to the work of reorganization. Consult: Davidson, 'The Island of Formosa' (1903); Guillemard, 'Cruise of the Marchesa'; Girard de Rialle in 'Revue d'Anthropologie' (1885).

Formosa, South America, a province of Argentine, in the northeastern portion of the republic. It has an area of 42,000 square miles, and pop. (1900) 6,000.

Formo'san Deer, a small spotted deer (*Cervus taevanus*), allied to the Japanese sika (q.v.) and a favorite pet among the people of Formosa, who catch the fawns in the mountains.

Formosus, fôr-mō'sus, Pope: b. about 816; d. 896. He became cardinal bishop of Porto in 891 and succeeded Pope Stephen V. in 891. He condemned Photius, excommunicated the Emperor Lambert, Duke of Spoleto, and nominated in his place Arnoul, king of Germania. Stephen VI., his successor, had his body disinterred as that of a usurper, but under John IX., in 898, his pontificate was pronounced valid.

Forms of Address in the United States are neither so complicated nor so rigidly arranged as in countries where careful gradations of rank and title obtain. Usage, however, sanctions the forms given in the following list:

The President of the United States, governors of States ambassadors, and ministers,— "His Excellency."

The Vice-President of the United States, the heads of the executive departments, justices of supreme and superior courts, lieutenant-governors of States, and mayors,— "The Hon. ——."

Senators and representatives of the United States, or of States,— "The Hon. ——."

Ex-presidents, or ex-officials of any of the ranks above cited,— "The Hon. ——."

Archbishops, if cardinals,— "His Eminence the Cardinal Archbishop of ——."

Archbishops, if not cardinals,— "The Most Rev. the Archbishop of ——."

Bishops, in the Roman Catholic and Protestant Episcopal Churches,— "The Right Rev." or "The Right Rev. the Bishop of ——."

Bishops, in the Methodist Episcopal Church,— "The Rev. Bishop."

The designation "Esquire," once chiefly applied to lawyers, is now frequently employed in addressing gentlemen of position.

The forms of address used in foreign countries, particularly those monarchical in government, are arbitrary and elaborate.

Formula, Chemical. See CHEMISTRY.

Form'ulary, National, a volume published by a committee of the American Pharmaceutical Association containing prescriptions with directions for making a large number of widely used combinations of drugs. These combinations have been used in the treatment of disease for many years, and a more extended use of the formulary by the physician would do away with many of the proprietary remedies on the market.

Fornáris, José, hō sā' for-nä'rēs, Cuban poet: b. Bayamo, Cuba, 1826. He wrote the dramas 'The Daughter of the People,' and 'Love and Sacrifice'; and is the author of: 'The Harp of the Home'; 'Songs of the Tropics'; and other volumes of verse.

For'ney, John Weiss, American journalist: b. Lancaster, Pa., 30 Sept. 1817; d. Philadelphia 9 Dec. 1881. He was apprenticed in the office of the Lancaster *Journal* in 1833; was clerk in the National House of Representatives from 1851-5; and secretary of the United States Senate from 1861 to 1868. He was connected with several papers in Philadelphia and Washington. Author: 'What I Saw in Texas' (1872); 'Anecdotes of Public Men' (1873); 'Forty Years of American Journalism' (1877).

Fornix. See BRAIN.

For'rest, Edwin, American actor: b. Philadelphia 9 March 1806; d. there 12 Dec. 1872. In 1820 he made his first appearance in public in the part of Douglas in Home's tragedy of that name, and coming before the New York public in 1826 in the character of Othello, at once gained popularity. In 1836 he crossed the Atlantic and entered on a season at Drury Lane Theatre, London. In the parts of Macbeth, Lear, and Othello he achieved distinguished success, and acquired the friendship of Macready, Kemble, and others. He again visited England in 1845, and on this occasion quarreled bitterly and causelessly with Macready, whom he accused of trying to damage his reputation from professional jealousy. This quarrel crossed the Atlantic, and when Macready was playing in the Astor Place Theatre, New York, in 1849, the partisans of either actor stirred up a riot that was accompanied by serious loss of life. Between 1853 and 1860 he retired from professional life, but when he returned to the New York stage he filled the role of Hamlet with all his former acceptance. Latterly he suffered considerably from illness, and his last engagement was in 1871. He was a man of fine presence, well equipped for his profession, naturally frank and engaging. He left a large fortune. See Rees, 'The Life of Edwin Forrest' (1874); Alger, 'Life of Edwin Forrest' (1877); Barrett, 'Edwin Forrest' (1882).

Forrest, SIR **John,** Australian explorer and politician: b. Western Australia 22 Aug. 1847. He entered the survey department of Western Australia in 1865, and in 1874 was at the head of a party which explored the interior from Champion Bay on the west to the overland telegraph line connecting Adelaide on the south with Port Darwin on the north coast. After holding various government posts he was returned unopposed in 1890 to the first Western Australia Legislative Assembly for Bunbury, and became the first premier and treasurer of the colony. In 1897 he presided over the Federal Council of Australasia, and was postmaster-general of Australia 1900-1. His publications are: 'Explorations in Australia' (1876); and 'Notes on Western Australia' (1884-7).

Forrest, Nathan Bedford, American soldier: b. Bedford County, Tenn., 13 July 1821; d. Memphis, Tenn., 29 Oct. 1877. He was descended from ancestors famous for gallantry on the patriot side during the American Revolution. Moving with his father to Marshall County, Miss., he was in a short while, by the death of his father, left to support his mother and family as best he could with a small hill farm. He undertook this work with devotion and energy, and, getting into business in Memphis, became able to purchase a large plantation, and was at the outbreak of the Civil War one of the wealthiest planters in Tennessee. Circumstances had forced him to neglect his own education, though he provided liberally for that of his brothers and sisters. On 14 June 1861 he entered the Confederate service as a private in White's mounted rifles, but soon obtained authority to raise a regiment, which he did, purchasing at his own private expense its equipment in Louisville, Ky. These supplies he carried to Memphis, displaying remarkable ingenuity and daring both in eluding the Federal authorities and in defeating a body of their troops with 75 Kentucky Confederates who had come to his assistance. Joining his regiment to the force defending Fort Donelson in February 1862, he was distinguished in the fighting at that point, and, when his superiors had determined upon surrender, led his men through a sheet of icy water past the Federal lines and escaped. Joining Albert Sidney Johnston (q.v.), he was distinguished at Shiloh, where he received a painful wound, which, however, did not long keep him from the field; and by a series of successful movements in Middle Tennessee, then occupied by the Federals, he rapidly rose to great distinction as a cavalry leader, and on 21 July 1862 was promoted brigadier-general. During Bragg's Kentucky campaign he performed great services both on the advance and retreat. Among his most famous exploits in Middle Tennessee was the expedition in which, with less than 1,000 men, he captured McMinville, and, surprising a garrison of 2,000 Federals at Murfreesboro, captured all the survivors of the fight, including Gen. Crittenden. On 8 May 1863 he captured a raiding force of Federals under Gen. Streight, near Rome, Ga., the Federal force being so much larger than his own that he pressed into service all the citizens in reach in order to form an adequate guard.

After highly distinguished service at the battle of Chickamauga, he was so dissatisfied with the failure to reap the full fruits of that great victory that he tendered his resignation. This was not accepted, but, instead, he was promoted major-general and assigned to the command of all the cavalry in West Tennessee and North Mississippi. Entering West Tennessee with a small force, he was reinforced by several thousand hardy volunteers, who, with his veteran troops, were soon welded into an invincible body known as «Forrest's cavalry.» In February 1864 he routed Gen. S. Smith at Okatona, Miss.; then swept northward through Tennessee to the Ohio River, capturing Fort Pillow, Union City, and other posts, with their garrisons. In June 1864, with a much smaller force than the enemy, he defeated Gen. Sturgis at Brice's Cross Roads (or Tishamingo Creek), near Guntown, in North Mississippi, capturing all his trains and a third of his men. Gen. A. J. Smith then advanced against him, but after fighting a desperate battle at Harrisburg, near Tupelo, in Mississippi, retreated. Receiving reinforcements from Memphis, Smith advanced again, but Forrest foiled him by making a 60-hour ride to Memphis with half of his force, and by his daring entry into that city compelled Smith's rapid retreat. Then Forrest made havoc with Federal transportation, capturing garrisons and depots in Tennessee, and crowning his exploits by the capture and destruction of $6,000,000 worth of Federal supplies and a gunboat fleet at Johnsonville. Sherman

wrote of this as a feat of arms which excited his admiration. Upon Hood's advance into Tennessee, Forrest joined him at Florence and performed important services. As commander of the rear guard of the Confederate army during the retreat from Nashville, his display of heroic qualities and brilliant leadership increased his already great fame. In February 1865 he was promoted lieutenant-general, and to him was assigned the duty of guarding the Confederate frontier from Decatur, Ala., to the Mississippi River. The surrender of the remnant of his command took place on 9 May 1865. During his career he had captured 31,000 prisoners. After the War he returned to civil life.

JOSEPH T. DERRY,
Author of 'The Story of the Confederate States.'

Forrester, Fanny, pen-name of EMILY CHUBBUCK JUDSON (q.v.)

Forsh'ey, Caleb Goldsmith, American engineer: b. Somerset County, Pa., 18 July 1812; d. Carrollton, La., 25 July 1881. He was educated at Kenyon College, Ohio, and the United States Military Academy, was professor of mathematics and civil engineering in Jefferson College, Mississippi, 1836–8, and from 1851–3 was engineer-in-charge of the governmental survey of the Mississippi delta. Though actively opposed to the secession movement, he became lieutenant-colonel of Confederate engineers upon the withdrawal of Texas from the Union. He collaborated in 'The Physics of the Mississippi River' (1861).

Forskâl, fôr'skâl, **Peter,** Swedish botanist: b. Helsingfors 11 Jan. 1732; d. Djerim, Arabia, 11 July 1763. In 1761 he was selected by Frederick V. of Denmark to join the scientific expedition to Arabia, to take charge of the department of natural history. He set out on this expedition with Niebuhr, Von Haven, and Kramer, and collected plants in the environs of Marseilles, of which he published a 'Flora' at Malta. Niebuhr collected Forskal's papers, accompanied them with remarks, and published them under the titles: 'Descriptiones Animalium, Avium, Amphibiorum, Piscium, Insectorum, quæ in Itinere Orientali observavit P. Forskal' (1775); 'Flora Ægyptiaco-Arabica, etc.'; 'Icones Rerum Naturalium, quas in Itinere Orientali depingi curavit Forskal' (1776).

Forster, Johann Reinhold, yō'hän rīn'hōlt fôr'stĕr, German naturalist: b. Dirschau, Prussia, 22 Oct. 1729; d. Halle 9 Dec. 1798. In 1753 he became pastor at Nassenhuben, but devoted most of his time to the study of mathematics, natural philosophy, natural history, and geography. In 1772 he received the offer of naturalist to Capt. Cook's second expedition to the South Seas. In association with his son, he published a work on the botany of the expedition, and 'Observations Made During a Voyage Round the World.' He wrote also: 'Introduction to Mineralogy'; 'Flora of South America'; 'Zoology of India'; etc.

Forster, fôr'stĕr, **John,** English historical writer: b. Newcastle-on-Tyne, England, 2 April 1812; d. London 2 Feb. 1876. He was educated for the law; held one or two public offices, and finally engaged in literature and journalism and was editor of the London 'Examiner' for nine years. He is best known for his 'Life of Charles Dickens' (1871–4). He also wrote: 'Statesmen of the Commonwealth of England' (1831–4); 'Life of Oliver Goldsmith' (1848); 'Walter Savage Landor' (1869;) etc.

Forster, fôr'stĕr, **William Edward,** English statesman: b. Bradpole, Dorsetshire, 11 July 1818; d. London 5 April 1886. He was educated at the Friends' School at Tottenham, and was active in the woolen trade in Bradford. In 1850 he married the eldest daughter of Dr. Arnold of Rugby. In 1865 he became under-secretary for the colonies; in 1868 was appointed vice-president of the council on education and a privy councilor; and in 1870 accepted a seat in Gladstone's cabinet, and carried through Parliament the Elementary Education Bill (1870) and the Ballot Bill (1872). In 1880 he accepted the post of chief secretary for Ireland at a time when that country was distracted by political and agrarian tumults. To mitigate the severity of the numerous evictions he introduced a Compensation for Disturbance Bill (1880), which was rejected by the House of Lords. The following year he introduced a Land Bill and a Coercion Bill, both of which were passed, and in order to check the growing power of the Land League he declared that organization illegal, and imprisoned Parnell and other members of his party. In April 1882 the government resolved to release the Parnellites and adopt a more conciliatory policy, whereupon he resigned his office. Subsequently he was often found acting in opposition to the government, chiefly in reference to foreign affairs, and he was also opposed to a separate Irish parliament in Dublin. His opinion on the latter question carried great weight because of his well-known sympathy for Ireland, his abilities as a statesman, his experience in affairs, and his unquestioned honesty. Consult 'Life of Forster,' by Wemyss Reid (1888).

Forsyth, George Alexander, American military officer: b. Muncy, Pa., 7 Nov. 1837. He served with distinction in the Civil War; was brevetted colonel for gallant services at Five Forks, and brigadier-general in 1868 for his action in an engagement with hostile Indians. He was a member of the board of officers to inspect the armies of Europe and Asia in 1875–6, and on staff and frontier service till 1890, when he was retired on reaching the age limit. He has published: 'Thrilling Days in Army Life' (1900); 'The Story of the Soldier' (1900).

Forsyth, John, American politician: b. Fredericksburg, Va., 1780; d. Washington 21 Oct. 1841. He was graduated at Princeton College in 1799, and was admitted to the bar in Augusta, Ga., in 1802. He was elected attorney-general of the State in 1808, representative in Congress in 1812, and United States senator in 1818. In 1820 he was sent to Spain as resident minister, where he conducted the negotiations concerning the ratification and execution of the treaty by which Florida was ceded to the United States. In 1823 he was again chosen to the House of Representatives, and was one of the main supporters in Congress of Gov. Troup of Georgia in his contest with the national government concerning the removal of the Creek and Cherokee Indians. He became governor of Georgia in 1827, and in 1829 was again returned to the United States Senate. He opposed the South Carolina movement of nullification from

its beginning, and voted in favor of Mr. Clay's compromise act of 1833. In the debate in 1834 on the removal of the deposits from the United States bank, he supported the President, who afterward appointed him secretary of state, an office which he retained till the retirement of President Van Buren in 1841.

Fort Adams, R. I., a United States military post established 1841, at Brenton's Point, R. I., near Newport. There was a garrison here during the Revolution. See MILITARY POSTS, U. S.

Fort Anderson. See WILMINGTON, CAPTURE OF.

Fort Ann, N. Y., a village and former fort in Washington County; on Wood Creek and Champlain Canal. The first fort was built here in 1709, rebuilt in 1757. The British captured the fort in 1777, and partially destroyed it. Pop. of village (1901) 430.

Fort Blakely, Siege and Capture of. Fort Blakely was erected by the Confederates as one of the inland defenses of Mobile, on the east bank of the Apalachee River, and opposite its confluence with the Tensas, about 10 miles northeast of the city. It was on high ground and nearly 3 miles in extent, with 9 well-built redoubts or lunettes armed with about 40 guns. In front was a deep and broad ditch, also an abatis. The garrison consisted of Gen. F. M. Cockrell's division of veteran troops and Thomas' division of Alabama Reserves, in all about 3,500 men, under command of Gen. St. John Lidell. On 20 March 1865 Gen. F. Steele set out from Pensacola and, by a circuitous march of 100 miles, reached the rear of the fort 1 April and invested it on the 2d with Garrard's division of the 16th corps, Veatch's and Andrews' divisions of the 13th, and Hawkins' division of colored troops, in all 13,000 men. Gradual approaches were made, accompanied by heavy and constant skirmishing, and by the 8th Steele had portions of his advanced lines within 450 to 600 yards of the works and 28 guns in position. A general assault was made about 6 P.M. of the 9th; there was a severe struggle in overcoming the obstructions in front of the work; but they were carried and the main works taken by assault, with 3,432 prisoners, 40 guns, and 16 battle-flags. The Union loss was 113 killed, 516 wounded. The Confederate loss is not known. The assault on Blakely was the last considerable engagement of the War, and was followed by the fall of Mobile and surrounding forts and by the surrender of the Confederate navy in the harbor. Consult: 'Official Records,' Vol. LI.; Andrew, 'Siege of Mobile.'

E. A. CARMAN.

Fort Bliss, Tex., a former United States military post on the Rio Grande, 3 miles from El Paso, established 1868. For the present post of this name at El Paso, see MILITARY POSTS, U. S.

Fort Bowyer, bō'yėr, Ala. (present site of Fort Morgan), a former United States fort at the entrance of Mobile Bay. It was built in April 1813 and was surrendered to the British 8 Feb. 1815.

Fort Can'by, Wash., a United States military post formerly called Fort Cape Disappointment, established on the north shore of the mouth of the Columbia River in 1864. See MILITARY POSTS, U. S.

Fort Caswell, kaz'well, N. C., a United States military post, established 1825, on Oak Island, Cape Fear River. See MILITARY POSTS, U. S.

Fort Chippewy'an, or **Chipeway'an,** Canada, a trading station on Lake Athabasca, owned by the Hudson Bay Company.

Fort Clark, Tex. See MILITARY POSTS, U. S.

Fort Clinton, N. Y., a fort built on the Hudson River, near West Point, in 1777. It was soon after abandoned.

Fort Collins, Colo., a city and county-seat of Larimer County, on the Colorado & S. R.R.; 74 miles north of Denver. The State Agricultural College is here. Pop. (1900) 3,050.

Fort Columbus, N. Y., a United States military post established on Governor's Island, New York harbor, in 1806. It is the headquarters of the Department of the East and has Castle William, military prisons. See FORTIFICATIONS; MILITARY POSTS, U. S.; MILITARY PRISONS, U. S.

Fort D. A. Russell, Wyo. See MILITARY POSTS, U. S.

Fort Darling (Drewry's Bluff), Attack on, 7 May 1862. President Lincoln, then at Fort Monroe, received a dispatch from Gen. McClellan that his cavalry had made a reconnaissance to Jamestown, on James River, that a Confederate battery at that point had been abandoned, and if it were possible for the Galena and other gunboats to move up James River, it would aid him in his movement up the Peninsula on Richmond. The President directed Flag-officer Goldsborough, if he deemed it proper, to send the Galena and two gunboats. On the morning of 8 May Capt. John Rodgers, with the Galena, Aroostook, and Port Royal, went up the river and engaged two batteries of 10 guns each, one of which he silenced; the other he passed, two Confederate gunboats retiring up the river as he approached. Rodgers worked his way up the river, meeting with no serious opposition until he arrived at Fort Darling, on Drewry's Bluff, eight miles below Richmond, a strong position on the right bank of the river, about 200 feet above it, and mounting five heavy guns, manned by the crews of the destroyed Merrimac and other ships at Norfolk, under command of Captain Farrand, C. S. Navy. The guns were mounted in such position as to give a close and plunging fire upon an advancing vessel. At the foot of the bluff the river had been obstructed by piles and sunken vessels secured by chains, and the shore was lined with rifle-pits, sheltering sharpshooters. Rodgers was now joined by the Monitor and Naugatuck, and on the morning of the 15th ran up and opened fire, the Galena leading and anchoring within 600 yards of the fort. The Monitor could not bring her guns to bear, and the action was principally confined to the Galena, which, after a contest of nearly three and a half hours, withdrew, having been struck 28 times, and losing 24 men killed and wounded. Two of the Confederate guns were dismounted, and Farrand reported a loss of 7 men killed and 8 wounded. Two or three

days later, recognizing the fact that the co-operation of the army was needed to carry the position, Goldsborough proposed to McClellan a joint attack, but McClellan preferred waiting until he got his army across the Chickahominy. The Confederates strengthened the position and it remained in their possession until the close of the war, an obstacle to the advance of the gunboats up the James to Richmond, and also to the operation of the army investing Richmond and Petersburg. Consult: 'Naval War Records,' Vol. VII., Allan, 'Army of Northern Virginia.'

E. A. CARMAN.

Fort Dearborn, Ill. See CHICAGO.

Fort de France, fōr dė fräṅs, or **Fort-Royal,** fōr-rwä-yal, Martinique, French West Indies, a town and seaport; situated on the north side of a deep and well-sheltered bay protected by a fort. The principal buildings are the parish church, government offices, the barracks, arsenal, prison, and hospital. Fort Royal is the residence of the French governor. Pop. (1900) 17,800. See MARTINIQUE.

Fort Dodge, Iowa, a city and county-seat of Webster County; on the Des Moines River, and on the Illinois C., and Chicago, R. I. & P. R.R.'s. A former fort here was called Fort Clarke. Pop. (1900) 12,162.

Fort Donelson. See FORT HENRY AND FORT DONELSON.

Fort Douglas, Utah, a United States military post three miles east of Salt Lake City. See MILITARY POSTS, U. S.

Fort Du Pont, Del. See MILITARY POSTS, U. S.

Fort Du Quesne, Pa. See PITTSBURG.

Fort Edward, N. Y., colonial, on the upper Hudson at its great bend, where stands the present village of Fort Edward; then known as the Great Carrying Place (that is, to Lake George), and an obvious advanced post for Canadian wars. Francis Nicholson built a stockade there for that purpose in 1799; it rotted away in disuse, but in 1755, at the opening of the French and Indian War, Phineas Lyman began another called by his name. It was finished by Col. Blanchard under Sir William Johnson, who after the battle of Lake George (q.v.) renamed it Fort Edward, after the Duke of York, grandson of George II. In 1757 it was raided from Canada and 11 soldiers killed. Later, the survivors of the massacre of Fort William Henry (q.v.) were sent there by Montcalm, and shortly afterward several thousand militia flocked thither to the rescue, but had to be sent home as too late. In March 1758 an expedition from there under Major Robert Rogers was nearly destroyed by the Indians. In the Revolution it was successively the headquarters of Schuyler and Burgoyne. Jane McCrea (q.v.) was living there when she started on her ill-fated journey 27 July 1777 to meet her lover in Burgoyne's camp, and was buried within the fort. See Parkman, 'Montcalm and Wolfe' (1884); 'Fort Edward in 1779-80,' 'Historical Magazine,' 2d series Vol. II. (1867).

Fort Erie, Canada, a former fort opposite Buffalo, built during the War of 1812; also a former fort at Erie, Pa.

Fort Ethan Allen, Vt. See MILITARY POSTS, U. S.

Fort Fisher, in North Carolina, erected by the Confederates on the peninsula between Cape Fear River and the Atlantic to defend the entrance to the port of Wilmington, was one of the most formidable earthworks on the Atlantic coast and was built to withstand the heaviest artillery fire. Its parapets were 25 feet thick, with an average height of 20 feet, and mounted 44 heavy guns. At the close of 1864, when it was determined by the United States forces to reduce it and close the port of Wilmington to blockade-runners, it had a garrison of 1,400 men, under command of Col. William Lamb. The combined naval and army expedition sent against it was under command of Admiral D. D. Porter and Gen. B. F. Butler. Porter's fleet of about 150 vessels, the largest that had ever sailed under the Union flag, left Hampton Roads 13 Dec. 1864 and arrived in sight of the fort on the 20th. As a preliminary to the attack the old steamer Louisiana was loaded with 215 tons of powder which was to be exploded under the walls of the fort, with the expectation that the explosion would dismount the guns, level the works, and demoralize the garrison, thus allowing the troops to land and easily take the work. At 1:40 A.M. of the 24th, without notifying Butler of the fact, when the Louisiana was within 300 yards of the beach and 400 yards of the fort, the powder was exploded, but did no damage, scarcely disturbing the slumbers of the garrison. At daylight the fleet ran in, and at 11 o'clock opened a furious fire, which was continued several hours, doing no material damage, and was responded to with spirit and effect. On the 25th the bombardment was renewed and under cover of it Butler landed 3,000 men two miles above the fort, and was assured by Porter that the navy had so completely silenced the work that all he had to do was to march his troops into it. But Butler and Weitzel, who was in immediate command of the troops, after a careful reconnaissance found the fort uninjured, deemed it unadvisable to attack it, re-embarked the men, and returned to James River to assist in the siege of Petersburg. Porter's fleet lost 83 men killed and wounded. The Confederates had 58 killed and wounded. The failure to take the fort produced great disappointment; it is now generally conceded that Butler and Weitzel acted wisely in not making the attempt. A second expedition against the fort sailed 12 Jan. 1865, and on the 13th 8,000 men were landed under Gen. A. H. Terry, who had been designated to command the land forces, which, as before, were under the immediate command of Gen. Weitzel. At 3.30 P.M. the fleet stood in and began a furious bombardment, which was continued next day, causing a loss to the garrison of 200 men, and silencing many of the guns. A combined naval and land attack was planned for the 15th, and 1,600 sailors and 400 marines were landed to co-operate with the army. The fleet opened fire at 9 A.M. and continued it until 3 P.M., when 50 steam-whistles from the fleet gave the signal for the land assault. The naval column, armed with cutlasses and pistols, charged the right flank or sea-face of the work, reached its foot, and those in advance began to climb the parapet, but the Confederates mounted on it repulsed them, and the entire body retreated in disorder with a loss of 82 killed and 269 wounded. The army was more successful; advancing on the left flank or land-face of the work, it forced a lodgment, and

after a hard struggle, which was continued far into the night, carried the entire work, capturing, as reported by Gen. Terry, about 2,000 men, with a loss of over 900. The Confederate defense of the fort was one of the most gallant of the War, and cost them about 500 killed and wounded. The Union loss, army and navy, was 266 killed, 1,018 wounded, and 57 missing. The fall of Fort Fisher closed the port of Wilmington, and was soon followed by the fall of that city. Consult: 'Official Records,' Vol. XLII.; 'Naval War Records,' Vol. XI.; Ammen, 'The Atlantic Coast'; Maclay, 'History of the Navy,' Vol. II.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. CARMAN.

Fort Gaines and **Fort Morgan.** Fort Gaines was a walled work on Dauphine Island, at the western entrance of Mobile Bay, and with Fort Morgan, a much larger work, on Mobile Point, nearly four miles distant, at the eastern entrance, was seized by the governor of Alabama 5 Jan. 1861. Both forts remained in Confederate possession until August 1864, at which time Fort Gaines had 30 guns. Fort Morgan was armed with over 40 guns, and had a mortar battery in front of seven heavy guns. Admiral Farragut attacked and passed both works when he ran into Mobile Bay, 5 Aug. 1864, and virtually destroyed the Confederate squadron. Gen. Gordon Granger landed troops on Dauphine Island on the 4th and began to invest Fort Gaines; on the 6th Farragut shelled it, and on the 7th the fort and its garrison of 818 officers and men surrendered. Fort Morgan held on longer, but Granger transferred his troops from Dauphine Island to the rear of the fort, invested it, got 34 guns in position to bear on it, and on the morning of the 22d, in co-operation with Farragut's fleet, opened his guns upon it, and kept up a continuous fire until the morning of the 23d, when the fort surrendered to Farragut.

E. A. CARMAN.

Fort Garry, Canada. See WINNIPEG.

Fort George, Canada, a former fort on the Canadian side of the Niagara River. On 27 May 1813 it was captured by the American forces under Col. Winfield Scott. On 10 Dec. 1813 the fort was evacuated by Gen. McClure. See FORT GEORGE, BATTLE OF.

Fort George, Battle of, 27 May 1813, in the War of 1812. The fort was near the mouth of the Niagara River, on the Canada side, nearly opposite Fort Niagara, and was garrisoned by about a thousand British regulars and several hundred militia under Gen. Vincent. The American force of some 4,000 undertook to take it in rear and capture the garrison; the nominal commander was Morgan Lewis, the real one Winfield Scott. The forces were landed from the fleet, nominal commander Chauncey, real one Oliver Hazard Perry, and a joint attack was made. The fleet enfiladed the beach; Scott advanced along the shore, and made a flanking movement. Vincent evacuated the fort, spiked the guns, and slowly retreated, parallel to the river, beyond Queenston Mt., losing 51 killed and 305 wounded and missing, from his regulars, while most of the militia were captured. American loss, 40 killed, 120 wounded. The other forts on the river were soon abandoned by the British.

Fort Getty, S. C. See MILITARY POSTS, U. S.

Fort Grant, Ariz., a United States military post and reservation at the foot of Mount Graham, established in 1863 by the California volunteers. See MILITARY POSTS, U. S.

Fort Greble, R. I. See MILITARY POSTS, U. S.

Fort Griswold, Conn. See FORT GRISWOLD, MASSACRE OF; MILITARY POSTS, U. S.

Fort Griswold, griz'wōld, **Massacre of,** 6 Sept. 1781. Hearing of Washington's southern march, Sir Henry Clinton, as the only available diversion, sent an expedition against New London, Conn., where a quantity of stores were collected, with slight defense from Fort Trumbull on the New London side and Fort Griswold on the Groton side of the Thames, and which was a nest of privateers that had greatly annoyed the British. Benedict Arnold was selected to head it, as a Connecticut man; an ugly method of making him seal his new allegiance. On taking possession of Fort Trumbull, it became evident that the American shipping would escape unless Fort Griswold were captured also; it was reported unfinished and occupied only by 20 or 30 men, and he ordered an attack on it. Shortly seeing that it was stronger than he supposed, and garrisoned by those who had escaped from Fort Trumbull, and that the ships were escaping up the river, he countermanded the order, but too late. The British detachment of 600 regulars had assailed the fort, where 157 militia had gathered; and after 40 minutes' assault, with the loss of 192 men, the British carried it, and despite the appeals for quarter, massacred nearly the whole garrison. Col. Ledyard, the commander, and 70 others were killed, 60 wounded, 35 mortally, and only 26 escaped unhurt. The British officers, however, did their best to stop the slaughter, and the atrocious story formerly told of the murder of the colonel is fiction. The massacre of garrisons *in terrorem,* to teach them not to defend untenable places, was justified by the European rules of war at the time, but had not been practised in America. Even American officers, however, spoke of it at the time as a regrettable but almost inevitable incident of war.

Fort Hamilton, N. Y., a United States military post at the Narrows, New York Bay, established in 1831. See MILITARY POSTS, U. S.

Fort Hancock, N. J. See MILITARY POSTS, U. S.

Fort Harrison, Battle of (including Chaffin's Farm, Fort Gilmer, and New Market Heights). In the latter part of September 1864 Gen. Grant ordered a movement against the Confederate troops north of James River, defending Richmond. Grant hoped to make Gen. Lee so weaken the garrison at Petersburg that the Union forces might carry it. The great object, however, was to prevent Lee sending reinforcements to Early in the Shenandoah Valley. September 28, during the night, Gen. Ord crossed from the south to the north bank of the James, and on the 29th, with 4,000 men, driving before him the Confederate outposts, appeared before Fort Harrison, on Chaffin's Farm, the strongest work on the Confederate line. Birney, with 10,000 men, moved by roads farther to the right. Stannard's division, which led the ad-

vance of Ord's column, moved to the assault of Fort Harrison, under a very severe fire of artillery and musketry, and after a sharp encounter carried it with its 16 guns and nearly 300 prisoners, at a loss of over 500.

Ord, being severely wounded, the command of his corps fell to Gen. Heckman, whose division, following Stannard's, passed to the right of Fort Harrison, attacked Fort Gilmer, and was repulsed with heavy loss. Meanwhile Gen. Birney had advanced on the New Market road, captured some of the advanced rifle-pits, running northeast from Fort Harrison, and established connection with Heckman. Gen. Grant now appeared and ordered an advance on the right. At 3 P.M. Birney made another assault upon Fort Gilmer, but was badly repulsed. Grant ordered the troops to entrench. Gen. Lee transferred seven brigades from his lines at Petersburg to the north side of the river, and massed 10 brigades at and near Fort Gilmer to assault and retake Fort Harrison. The assault was made at 2 P.M. of the 30th by Gen. R. H. Anderson, commanding Longstreet's corps, with five brigades, and was repulsed. Twice the Confederates re-formed and renewed the assault, but were repulsed, leaving a large number of killed and wounded and seven battle-flags on the ground, and the effort to dislodge the Union troops was abandoned. The Union loss on the 29th and 30th was 383 killed, 2,299 wounded, and 645 missing, an aggregate of 3,327. The loss of the Confederates is not definitely known, but it was near 2,000 in killed, wounded, and missing. Consult: 'Official Records,' Vol. XLII.; Humphreys, 'The Virginia Campaign of 1864-65.'

E. A. CARMAN.

Fort Henry and Fort Donelson. These forts were constructed by the Confederates just south of the boundary line between Kentucky and Tennessee, the former on the right bank of the Tennessee River, the latter on the left bank of the Cumberland; the distance between the two being 12 miles. On 28 Jan. 1862 Commodore Foote and Gen. Grant asked Gen. Halleck's permission to take Fort Henry. Halleck assented, and on the morning of 2 February Foote's flotilla of ironclads and gunboats, followed by a fleet of transports, carrying Grant's troops, left Cairo, anchoring 6 miles below Fort Henry on the morning of the 4th. The fort was defended by 17 heavy guns, and its land approach was covered by rifle-pits held by 3,000 men. Gen. Lloyd Tilghman was in command. About 11.20 A.M. of the 6th Foote steamed up toward the fort and attacked it with four ironclads, Tilghman, with about 90 men to work 11 guns bearing on the river, returning the fire. After a contest of an hour and a quarter Tilghman hauled down his flag and surrendered with 78 men, having lost 16 killed and wounded. The 3,000 men in the rifle-pits retreated to Fort Donelson. The fleet had 29 killed and wounded. Grant, who had landed his troops 6 miles below the fort, arrived too late to take part in the action.

Grant reported to Halleck that on the 8th he would take and destroy Fort Donelson. Foote, however, was compelled to return to Cairo for repairs to his fleet, and the movement was deferred until the morning of the 12th, when Grant marched across the country, with about 16,000 men, arriving before Fort Donelson in the evening. The fort was on a commanding hill, 120 feet above the level of the Cumberland, with three heavy batteries commanding the river, and a line of rifle-pits to defend the land approach. On the morning of the 13th the fort and works were held by 18,000 men, under command of Gen. Floyd. The rifle-pits 2½ miles in extent, were held by Gen. Buckner on the right and Gen. Pillow on the left.

Grant formed his line of investment with Gen. McClernand on the right and Gen. Smith on the left, and at dawn of the 13th opened a furious cannonade and sharp skirmishing. In the evening Foote's flotilla and reinforcements for Grant arrived — Crufts' brigade and several regiments from Fort Henry and Cairo. These were formed into a division of 10,000 men, under Gen. Lew Wallace, and put in the line between McClernand and Smith, raising Grant's force to 26,000 men. At 2 P.M. of the 14th Foote attacked the fort, and at the end of an hour and a half was compelled to withdraw, two of his ironclads being entirely disabled and the other two partially so. He had 54 men killed and wounded. It was then concluded that Foote should return to Cairo and repair damages, while Grant should perfect his investment, fortify his lines, and await the arrival of reinforcements and the return of Foote.

The Confederates shaped the course of events otherwise. They decided to break the right of Grant's investing line and escape by roads leading to Nashville. In pursuance to the plan adopted, Pillow, on the Confederate left, supported by a part of Buckner's command, advanced at daybreak of the 15th, with 10,000 men, and after a hard fight gained the right of McClernand's line and forced it back. McClernand called for assistance and, in the absence of Grant, who had gone to confer with Foote, Lew Wallace sent Crufts' brigade to his support, but the Confederates continued to gain the advantage, pushing back McClernand's two right brigades and their supports. Buckner made an attack upon McClernand's left and was repulsed; but rallying his men, he renewed the attack, and the whole right wing of Grant's army was forced back, the Confederates still following up their advantage, when Wallace threw Thayer's brigade to the right and across their line of advance and, after a sharp fight, checked them, driving some back to their entrenchments. It was 2 P.M. when Grant came on the field to find nearly half his army driven from position and the way open for Confederate escape. He ordered a counter-attack. Smith, commanding on the left, formed a brigade in column, led it under severe fire, and seized the Confederate works in his front and on the high ground surrounding the fort. Wallace and part of McClernand's force, advancing on the right, gained the greater part of the ground lost early in the day, and by night the line of investment was re-established. Grant made preparations to renew the attack early next morning, but during the night the Confederate commanders came to the conclusion that escape was impossible, that Grant was too strong to be beaten, and that nothing remained but a surrender. Floyd, senior in rank, announced personal reasons against a surrender and passed the command to Pillow, who in turn passed it to Buckner. Floyd and Pillow, with the aid of two small steamboats, succeeded in getting away with about 1,200 officers and men, principally

of Floyd's old brigade, and Col. Forrest, with some 500 cavalry and other small detachments, escaped in the night by the river road.

At an early hour of the 16th, as Grant was about to renew the attack Buckner sent him a note proposing "the appointment of commissioners to agree upon the terms of capitulation," and suggesting an armistice until 12 o'clock. Grant replied: "No terms except unconditional and immediate surrender can be accepted. I propose to move immediately upon your works." Buckner surrendered 14,500 men, 57 guns, and a large amount of ammunition and stores. The Union loss, army and navy, was 510 killed, 2,152 wounded, and 224 missing. The Confederate loss, killed and wounded, was about 2,000. The capture of Forts Henry and Donelson broke the first line of Confederate defense in the Mississippi Valley, and caused the abandonment of Columbus, Bowling Green, and Nashville. Consult: 'Official Records,' Vol. VII.; Force, 'From Fort Henry to Corinth'; Swinton, 'Decisive Battles of the War'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. I.; Grant, 'Personal Memoirs,' Vol. I.

E. A. Carman.

Fort Hindman, or **Arkansas Post, Battle of.** After Gen. Sherman's failure at Chickasaw Bayou (26–31 Dec. 1862), his army and Admiral Porter's fleet returned to Milliken's Bend, where, 4 Jan. 1863, Gen. J. A. McClernand superseded Sherman in command and moved against Fort Hindman, situated on the north bank of the Arkansas River, 50 miles from its mouth, commanding the approach to Little Rock and protecting the valley of the Arkansas. The fleet, 3 ironclads and 6 gunboats, entered White River, and from it passed through a cut-off to the Arkansas, 9 January. The army of 29,000 men landed about four miles below the fort, a large square-bastioned work, on high ground, at the end of a horseshoe bend in the river, mounting 18 guns, and garrisoned by about 5,000 men, under command of Gen. T. J. Churchill. A line of rifle-pits surrounded it. The ironclads began the attack on the 10th, and the entire fleet, gradually moving up, shelled the Confederates out of the rifle-pits and back into the fort. On the 11th the navy opened a furious fire upon the fort, McClernand's artillery joining in the fire from the land side. Churchill's guns were silenced, and McClernand ordered a general assault. After a severe contest the fort was carried with a loss to the Union army of 134 killed, 898 wounded, and 29 missing. The naval loss was 6 killed and 25 wounded. The Confederate loss was 60 killed, about 80 wounded, and 4,791 captured. On the 12th McClernand received peremptory orders from Gen. Grant to return to Milliken's Bend with his entire command. The prisoners were sent to St. Louis, the fort was dismantled and blown up, and the fleet and troops went down the Arkansas to Napoleon, on the Mississippi. Consult: 'Official Records,' Vol. XXII.; Greene, 'The Mississippi'; Mahan, 'The Gulf and Inland Waters'; Maclay, 'History of the Navy,' Vol. II.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. III.

E. A. Carman.

Fort Holmes, Mich. See Mackinac Island.

Fort Howard, Md. See Military Posts, U. S.

Fort Independence, Mass. See Military Posts, U. S.

Fort Jackson and **Fort St. Philip.** Fort Jackson was built between 1824 and 1832 on the right bank of the Mississippi, about 80 miles below New Orleans. Together with Fort St. Philip on the opposite bank, half a mile above, it defended the city from water attack. Both forts were seized by Louisiana State troops 11 Jan. 1861, were strengthened and garrisoned, and remained in Confederate possession until taken by Admiral Farragut in April 1862, at which time they were garrisoned by about 700 men each. Fort Jackson was armed with 74 guns, Fort St. Philip with 52. In March 1862 Farragut assembled a powerful fleet at Ship Island and at Southwest Pass, at the mouth of the Mississippi, for the capture of New Orleans, and 18 April Commodore Porter, in command of a strong flotilla, opened fire upon Forts Jackson and St. Philip. During six days he threw 16,000 shells, but was unable to reduce the forts.

It was found necessary to run past the forts and destroy the Confederate navy above before New Orleans could be taken. On the 24th Farragut, with 17 vessels, in single line, carrying 192 guns, steamed up the river, engaging both forts with heavy broadsides, of shot, shell, and canister, receiving heavy fire in return. Passing the forts and obstructions, he engaged and destroyed the Confederate fleet, in one of the most spectacular naval battles of the War. Within an hour and a half after leaving its anchorage Farragut's fleet had passed the forts and destroyed 11 Confederate vessels. With 13 of his own vessels Farragut proceeded up the river, and at noon of the 25th anchored before New Orleans, which was abandoned by the Confederate troops holding it, and surrendered by the civil authorities. Porter, who had remained below, continued his bombardment of the forts, which were surrendered on the 28th. The Union loss was 37 killed and 147 wounded. The loss in the forts was 14 killed and 39 wounded; that in the Confederate navy is not known. Consult: The Century Company's 'Battles and Leaders of the Civil War,' Vol. II.; Mahan, 'The Gulf and Inland Waters'; Maclay, 'History of the Navy,' Vol. II.

E. A. Carman.

Fort Keogh, Mont. See Military Posts, U. S.

Fort Lafayette, N. Y. See Military Posts, U. S.

Fort Leavenworth, lev'en-worth, Kan., a United States military post and reservation, three miles from Leavenworth, established in 1827. There is here a military prison and national cemetery.

Fort Lee, N. J., a former fort in Bergen County, on the west bank of the Hudson River. On 20 Nov. 1776 Gen. Greene and the American forces evacuated Fort Lee, and narrowly escaped capture by 5,000 British under Cornwallis.

Fort Logan, Colo. See Military Posts, U. S.

Fort McAllister, an earthwork erected by the Confederates at Genesis Point as one of the defenses of Savannah. It was 12 miles south of the city and 6 miles from Ossabaw Sound. On 27 Jan. 1863 Admiral Dupont attacked it with five vessels, and again on 1 February, but without effect. On 3 March three monitors,

under command of Commodore Drayton, bombarded it, but did little injury. When Sherman, marching from Atlanta, appeared before Savannah the fort prevented communication between his army and the Union fleet, and Hazen's division of the Fifteenth corps was ordered to assault it. Hazen reached the vicinity of the fort about 11 A.M., 13 Dec. 1864, drove in the Confederate skirmishers, and at 4.15 P.M. had deployed nine regiments within 600 yards of the work. At that time the bugle sounded, and the line went forward over exploding torpedoes and under a close and severe fire of artillery and musketry, carrying the fort at 5 P.M. and capturing its garrison of about 250 men, 22 guns, and a large amount of ammunition. The Union loss was 24 killed and 110 wounded. The Confederate loss was about 50 killed and wounded.

E. A. CARMAN.

Fort McHenry, Md., a United States military post, on the Patapsco River, established in 1794. It was bombarded in 1814 by the British fleet, and was used as a rendezvous during the Civil War. See MILITARY POSTS, U. S.

Fort McPherson, Ga. See MILITARY POSTS, U. S.

Fort Macon, a work commanding Beaufort Harbor, N. C., constructed of brick and stone, and mounting nearly 50 guns. It was seized by Gov. Ellis, of North Carolina, about the middle of April 1861. After Burnside's capture of Newbern, 14 March 1862, Gen. Parke was sent to reduce the fort, then garrisoned by about 450 men. Parke captured Moorehead City and Beaufort, and then proceeded to invest the fort He cut off its communications, planted 11 siege-guns, and at 5:40 A.M. 25 April, in co-operation with four vessels of the navy, opened fire, and at 4 P.M. the fort surrendered with its entire garrison. Parke occupied it next morning and it remained in Union possession until the close of the War.

E. A. CARMAN.

Fort Madison, Iowa, a city and county-seat of Lee County, 18 miles from Burlington, on the Chicago, B. & Q. R.R. Here is the State penitentiary and the Catermole Memorial Library. There was a fort here as early as 1808, but was abandoned in 1832 when the town was established. Pop. (1900) 9,278.

Fort Meade, S. D. See MILITARY POSTS, U. S.

Fort Meigs, mĕgz, Ohio, a former fort on the Maumee River, where the Americans made a gallant defense in 1812 against the British and Indians. See FRENCHTOWN.

Fort Mer'cer, N. J., a former fort at Red Bank, on the Delaware River, that figured somewhat prominently in the Revolution. It was destroyed by the British 20 Nov. 1777.

Fort Mif'flin, Pa., a United States military post on Mud Island in the Delaware River. It was built in 1771 as one of the defenses for Philadelphia. It figured in numerous engagements in the Revolution. It is garrisoned at the present time. See MILITARY POSTS, U. S.

Fort Mims, Ala., Massacre of, a massacre of whites by Creek Indians at the temporary stockade, near Mobile, Ala., 30 Aug. 1813. Over 500 men, women, and children were killed by a large force of Indians under Weathersford, a half-breed.

Fort Monroe, Va., a United States military post at Old Point Comfort, commanding the entrance to Hampton Roads. Jefferson Davis (q.v.) was kept a prisoner here for two years after the Civil War.

Fort Montgomery, N. Y. See MILITARY POSTS, U. S.

Fort Morgan, Ala. See FORT GAINES AND FORT MORGAN.

Fort Moultrie, mōl'tri, S. C. When Major Anderson transferred his garrison from Fort Moultrie to Fort Sumter, 26 Dec. 1860, he spiked and dismounted the 52 guns of the fort and burned the gun carriages. The South Carolina authorities took possession of the fort on the 27th, remounted the guns, strengthened the work, increased its armament, and it became one of the strong defenses of Charleston Harbor, resisting all efforts of the Union fleet to pass it, or reduce it, and remained in Confederate possession until the evacuation of Charleston and all the forts in the harbor 17–18 Feb. 1865. See FORT SUMTER; FORT WAGNER. For early history see FORT SULLIVAN.

Fort Myer, Va. See MILITARY POSTS, U. S.

Fort Necessity. After the capture of Jumonville's force (see GREAT MEADOWS), Washington threw up earthworks and made a stockade fort, which he named as above. It soon became crowded with Indians and colonial companies, and a South Carolina company of regulars under Capt. Mackay; and Washington left the latter in command and moved 13 miles farther on, where was a small settlement. But the place was indefensible; and after summoning Mackay and his men it was decided to retreat to Fort Necessity. The next morning the French were upon them, 900 men besides Indians. Washington led out his men to battle, but the enemy kept off and fired from the woods, in a heavy rain. Washington withdrew his men behind the low, flimsy embankment; and after an entire day of mutual firing, with heavy loss on both sides, the French proposed a parley. The English were at the last extremity, with food and ammunition nearly exhausted, and guns in bad condition; and Washington would not consent to let them send an officer to his camp to observe this, and only yielded when they proposed to have him send one to theirs. The French terms were that the English should retire with all their baggage except artillery, agree to build no more forts beyond the Alleghanies for a year, return the Jumonville prisoners, and leave two officers with the French as hostages. The terms were accepted; but had the French held out a few hours more they could have killed or captured the entire force.

Fort Niag'ara, N. Y. As early as 1669 La Salle built a stockade at the mouth of the Niagara River, and Fort Conti, a fortified trading post was built here 10 years later. In 1686 it was called Fort Denonville and in 1725 it was named Fort Niagara. In July 1759 it was captured by the British and Indians under Johnson (see COLONIAL WARS), and was again captured by the British 19 Dec. 1813.

Fort Ninety-six, S. C. See NINETY-SIX.

Fort Payne, Ala., a city and county-seat of Dekalb County, on the Alabama G. S. R.R. It has large coal and iron industries. Pop. (1900) 1,037.

FORTRESS MONROE. OLD POINT COMFORT, VA.

Fort Pickens, a strong work on Santa Rosa Island, Fla., commanding the entrance to Pensacola harbor, and with Forts Barrancas and McRee opposite, defending the harbor and United States navy-yard at Warrington. Early in January 1861 it was under command of Lieut. A. J. Slemmer and practically unoccupied, Slemmer, with a small garrison, being at Fort Barrancas. Fearing that the secessionists would seize the fort, Slemmer, 10 January, transferred to it his garrison of 81 men from Barrancas, and on the 12th the governor of Florida seized Forts Barrancas and McRee, with 175 heavy guns, also the navy-yard, and demanded the surrender of Fort Pickens, which was refused. A second demand was made on the 15th and a third on the 18th, both of which were refused. Slemmer strengthened the work and held it until relieved by the arrival of reinforcements 12-13 April, when Col. Harvey Brown assumed command. Additional reinforcements were sent, and in June a regiment of New York troops, known as Wilson's Zouaves, was landed on Santa Rosa Island and encamped. On 9 October a body of Confederate troops, that had crossed from Pensacola and landed on the island during the night, surprised the camp of the Zouaves, and drove them back toward Fort Pickens, but the Zouaves being reinforced by four companies from the fort, the Confederates were driven in disorder to their vessels, with a loss of about 90 killed, drowned and wounded. The Union loss was 67 killed, wounded, and captured. No other serious attempt was made upon the fort, which remained in Union possession until the close of the War.

E. A. Carman.

Fort Pillow, constructed by the Confederates on the east bank of the Mississippi, about 40 miles above Memphis. It was bombarded by the Union fleet in its descent of the river and attack upon the Confederate fleet near Memphis, abandoned by the Confederates 4 June 1862, and 5 June was occupied by a small Union force. On 12 April 1864 it was garrisoned by parts of the 2d and 4th (colored) U. S. Artillery, and a detachment of the 13th Tennessee Cavalry, in all 557 men, with six guns, under command of Maj. L. F. Booth. At daybreak of the 12th Gen. J. R. Chalmers, of Forrest's cavalry command appeared before the fort with about 1,500 men, and after some hours of hard fighting drove the Union troops from their advanced rifle-pits back into the fort, which was attacked, and the Confederates repulsed, but securing a sheltered position within 100 yards of it. Forrest had come up while the fighting was in progress, and at 3.30 P.M. demanded the surrender of the fort, saying that he had sufficient force to take it, and would not be answerable for consequences should he be compelled to assault. Maj. Booth had been killed, but in his name an hour was asked for consideration. There were U. S. gunboats in the river, and believing that the request for an hour's consideration was to gain time for reinforcements to arrive, Forrest would give but half an hour. When the time was up the bugles sounded the charge, the assault was made, there was a short and severe struggle, many of the garrison were killed in the fort, and those who attempted to escape by the river were shot or, rushing over the bluff into the river, drowned. More than half of the garrison were killed or wounded, a very large proportion being killed. About 160 white and 40 colored prisoners were taken. The defenders of the fort fought bravely, but were simply overpowered. Forrest says in his report: "The river was dyed with the blood of the slaughtered for 200 yards. The approximate loss was upwards of 500 killed; but few of the officers escaped. There was in the fort a large number of citizens who had fled there to escape the conscript law. Most of them ran into the river and were drowned." Forrest reports his own loss as 20 killed and 60 wounded. Consult: 'Official Records,' Vol. XXXII.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. Carman.

Fort Porter, N. Y., a United States military post on the Niagara River in the city of Buffalo. It was established in 1867, but prior to that date the government maintained a defensive work at Black Rock.

Fort Preb'le, Me., a United States military post, at Spring Point, in Portland Harbor, established in 1808.

Fort Pulaski, erected by the United States on Cockspur Island, for the defense of Savannah, Ga., and commanding both channels of the Savannah River. It was a brick work, with walls 7½ feet thick and 25 feet high above water. It was seized by Georgia State troops 3 Jan. 1861, and in January 1862 mounted 48 heavy guns and was garrisoned by nearly 400 men. Gen. Q. A. Gillmore was put in charge of operations to reduce it, and in February 1862 2 regiments of infantry, 2 companies of engineers, and 2 of artillery were landed on Tybee Island, mostly a mud-marsh, lying southeast of the fort, and soon constructed 11 batteries of 36 heavy guns, at distances from the fort varying from 1,650 to 3,400 yards. Causeways had to be constructed across marshes, over which mortars of 17,000 pounds were moved; the work was done entirely at night; all difficulties were overcome; and on 9 April the batteries were ready to open fire, the three breaching batteries being established at a mean distance of 1,700 yards from the fort. At sunrise of the 10th the fort was summoned to surrender; its commander, Col. C. H. Olmstead, replied that he was there "to defend the fort, and not to surrender it." Fire was opened at 8 A.M., and an hour later all the batteries were in full play, the Confederates replying vigorously, the fire continuing on both sides until dark. Firing was resumed at sunrise of the 11th, and the Confederates replied steadily; but by noon several of the guns were dismounted; the walls of the fort began to crumble under the weight of metal; and at 2 P.M. the white flag was raised, firing ceased, and 385 officers and men were surrendered, several of whom were severely, one mortally, wounded. The Union loss was one man killed. The result of the fall of Fort Pulaski was the closing of the Savannah River to blockade runners.

E. A. Carman.

Fort Riley, Kan., a United States military post on the Kansas River, near Junction City, Kan. It was established in 1852 on a reservation of 19,000 acres and was first called Camp Centre. It is about 140 miles from Fort Leavenworth, with which place it is connected by a military road completed in 1854. An appropriation of $100,000 was made by Congress in 1855 for the extension of this road to Bridger's Pass,

between Nebraska and Utah, making it one of the finest roads in the country. The fort is the seat of the United States Cavalry and Field Artillery School and has accommodations for a large force of cavalry and infantry.

Fort Robinson, a United States military post in the Red Cloud Agency, situated in the western part of Dawes County, Nebraska, and on a fork of the White River, about three miles southeast of Crawford. The post dates back to 1874 and occupies about 20 square miles. There are accommodations for over 500 troops, with stables for the same number of horses.

Fort Royal, West Indies. See FORT DE FRANCE.

Fort Saint David, a town in the presidency of Madras, Hindustan, on the Coromandel coast, situated on the Tripapolore River, about 12 miles south-southwest of Pondicherry. It was besieged by the French in 1746, but withstood the siege and finally forced the French to retire. It remained in possession of the British and was the capital of their possessions in that section of India until 1750, when the French army under Gen. Lally again attacked the fort, this time with success, and razed the fortifications.

Fort St. Philip, La., a fort lying on the Mississippi River about 80 miles below New Orleans and nearly opposite Fort Jackson. The Spaniards originally built the old river front and it was not until the War of 1812 that the works were entirely enclosed by the United States government. Extensive alterations were made by the government after 1841. At the outbreak of the Civil War it was taken by the Confederates, but fell before the attack of Admiral Farragut's fleet in April 1862. See FORT JACKSON AND FORT ST. PHILIP.

Fort Sam Huston, hūs'tŏn, Texas, a United States military post near San Antonio, established in 1865. There is a reservation here of 469 acres.

Fort Sanders. See KNOXVILLE, SIEGE OF.

Fort Schuyler, New York harbor. See MILITARY POSTS, U. S.

Fort Schuyler (Old), N. Y. See FORT STANWIX; ROME, N. Y.

Fort Scott, Kan., city and county-seat of Bourbon County; on the Marmaton River, and on the Saint Louis & S. F., the Missouri, K. & T., and the Missouri P. R.R.'s., 100 miles south of Kansas City.

Industries.— The chief income of the city is derived from the railroad shops, the Saint L. & S. F. employing 500 hands and the Mo. Pac. 550 hands. The city is situated in a rich agricultural region, this in itself a valuable source of income. Besides these industries there are manufactories of cement, syrup, brick and machinery. Fort Scott is also the largest horse and mule market in the State.

Banks, Public Buildings, etc.—There are three banks with a combined capitalization of $200,000. Among the public institutions are the library containing 18,000 volumes, the Goodlander Home for Children, the old government fort buildings which have been preserved, and the National cemetery.

Church and Educational Institutions.— Religious services are held in 11 church edifices. The educational system is excellent, consisting of a high school and seven public schools. There are two commercial colleges in the city and the Notre Dame De Lourdes Academy is also located there.

History, Government and Population.— The city was first settled as a military post in 1844, became a municipality in 1850 and was chartered as a city of the first class in 1882. The public administration is vested in a mayor, and a city council composed of 10 members, five of whom are elected each year. The major portion of the population are native born, with a sprinkling of negroes, Germans, Jews, and Irish. Pop. (1900) 10,322; (1905) about 14,900.

GEORGE W. MARBLE,
Editor 'Tribune and Monitor'.

Fort Smith, Ark., city and county-seat of Sebastian County, situated on the western border of the State at the junction of the Arkansas and Poteau rivers, and on the Saint Louis & S. F., Missouri P., Kansas City S., Midland Valley, F. S. & W., and Ark. Cent. R.R.'s.

Industries.— The city is in a rich agricultural region and derives a greater part of its income from this source. There are also coal mines near by. The city has a wagon factory, several furniture and chair factories, a wood-working establishment, machine shops, cotton compress, and oil wells. There are two daily and several weekly papers published.

Schools and Churches.— The city has eight public schools, a high school, two commercial colleges, a Catholic Girl's Academy, three parochial schools, and two conservatories of music. There are 13 churches, representing nearly all denominations.

Banks, Public Buildings, etc.— There are four banks (three national and one savings), having a combined capital of $900,000. Among the notable public buildings are the Federal and County court-houses, the United States jail, and a hospital and an opera-house. A National cemetery is located on the site of the former "Post" burying ground.

History, Government and Population.— Fort Smith was originally a French trading post, and in 1817 became the headquarters for the gathering and distribution of supplies for the United States army in the Southwest. It was called Belle Point by the early settlers, was incorporated in 1842, and received its city charter in 1886. The city is governed by a mayor, a board of public affairs, and a council of 10 members elected for two years. The city is lighted by electricity, gas, and natural gas, owns its waterworks, and possesses an excellent system of electric railways. Pop. (1900) 11,587; (1905) about 27,000.

E. B. MILLER,
Secretary Commercial Club.

Fort Snelling, Minn. See MILITARY POSTS, U. S.

Fort Stanwix, N. Y., a former fort near the present site of Rome, N. Y., originally built in 1756, but abandoned, and rebuilt in 1758 by

Brigadier Stanwix. Here in the fall of 1768 a treaty was negotiated by Sir William Johnson (q.v.), the British superintendent-general of Indian affairs in North America, with the Six Nations, about 3,200 Indians being present. For the sum of $10,000, the Indians surrendered title to Kentucky, West Virginia, and western Pennsylvania. Soon after this the fort was again abandoned, but in 1776 it was once more rebuilt and named after that intrepid old soldier, Gen. Philip Schuyler. In 1777 the fort was the object of an attack by Gen. Saint Leger with 1,700 British soldiers and allies, but the garrison held out for 19 days, from 3-22 August when they were relieved by a force of Continentals under Gen. Arnold. In 1781 the fort was destroyed by flood and fire, and when rebuilt was again named Fort Stanwix. It was here on 22 Oct. 1784 that the three United States commissioners negotiated the treaty with the Iroquois Indians, known as the "Treaty of Fort Stanwix," which provided for the cession to the United States of western lands claimed by them.

Fort Stedman, Assault on. In March 1865 Gen. Lee prepared to abandon Richmond and Petersburg, unite with Johnston at Danville, and attack Sherman, who was marching northward from Savannah. In order that he might wait for favorable weather, he decided on a sortie against Grant, to hold him near the Appomattox. The sortie was committed to Gen. Gordon, with about one half of the army. The point of Gordon's attack was Fort Stedman. At 4 A.M. 25 March the attack was made, and a rush of Gordon's men overcame the pickets and advance guards, took from 400 to 500 yards of the main line (Willcox's), including Fort Stedman, the defenders of which, after a spirited resistance, were overpowered and captured, turned its artillery upon the Union line, captured between 500 and 600 prisoners, and endeavored to sweep down the intrenchments, but met with a repulse. It was so dark that friend could not be distinguished from foe, but Gen. Parke ordered Willcox to recapture the works, Gen. Hartranft to support him. By 7.30 A.M. Parke had regained a part of the line and drawn a cordon around Fort Stedman, and Tidball's artillery had concentrated a heavy fire upon it and the line adjacent. Hartranft advanced at 7.45 A.M., attacked detachments of the enemy that were moving in the direction of City Point, capturing or driving them back, and at 8 A.M. Fort Stedman and the entire line was recaptured, together with 1,949 prisoners and 9 stands of colors, the Federal loss (Ninth corps) being 72 killed, 450 wounded, and 522 missing. The Sixth corps now attacked and captured the Confederate picket-line, losing 449 killed and wounded, and 30 missing; and the Second corps did the same, capturing 365 prisoners, and losing 51 killed, 462 wounded, and 177 missing. The Confederates made several efforts to recapture their own advanced lines, but failed. The entire Union loss in this engagement was 170 killed, 1,323 wounded, and 729 missing, an aggregate of 2,222. The Confederate loss is not definitely known; Gen. Meade estimates it at 5,000 men; it was probably not over 4,000, of whom one half were prisoners. Consult: 'Official Records,' Vol. XLVI.; Humphreys, 'The Virginia Campaign of 1864-65'; Walker, 'History of the Second Army Corps'; Powell, 'History of the Fifth Army Corps'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. CARMAN.

Fort Stephenson, Ohio. See FREMONT, Ohio.

Fort Stevens, a United States military post in Oregon, situated in the extreme northwestern part of the State at the mouth of the Columbia River. It is a little more than 100 miles northwest of Portland and about 9 miles west of Astoria, the fur trading post, which was established by John Jacob Astor in 1811. The grounds surrounding the post which was established in 1864 comprise 1,250 acres, and, beside the quarters for the officers and artillerymen stationed there, has a post office and railway station.

Fort Sullivan, S. C., the early name of Fort Moultrie, in Charleston harbor; notable for its defense against the British in the Revolutionary War. See COLONIAL WARS.

Fort Sumter, built upon a shoal in the narrowest part of the channel of Charleston harbor, three and a half miles from the city, and three fourths of a mile from the north end of Morris Island, was constructed on a rip-rap foundation, its walls of brick being 38 feet high and 7½ feet thick. When South Carolina secede the fort was unfinished and not garrisoned, but men were engaged in the work and in mounting guns. South Carolina passed an ordinance of secession on 20 Dec. 1860, and the secessionists looked to the immediate possession of all the forts in the harbor, one of which, Fort Moultrie, was held by Maj. Robert Anderson, with a garrison of 75 men. Fort Moultrie was indefensible from a land attack, and Anderson, believing that he was about to be attacked, on 26 December, skilfully transferred his command to Fort Sumter, the strongest and most inaccessible work in the harbor. Gov. Pickens demanded Anderson's immediate return to Fort Moultrie, Anderson refused, and the governor took possession of Fort Moultrie and all other works in the harbor, and seized the arsenal, post-office, and custom-house in Charleston, raised the Palmetto flag over them, and thus inaugurated war against the United States. He began the construction of batteries on James, Morris, and Sullivan islands to command the harbor and reduce Fort Sumter. On 9 Jan. 1861 the merchant steamer Star of the West endeavored to land reinforcements and provisions for Fort Sumter, but was fired upon by the secession batteries and driven back. Again Gov. Pickens demanded the surrender of the fort, again Anderson refuced, and negotiations were transferred to Washington. The construction of batteries continued and 1 March Gen. Beauregard was assigned to the command of all the Confederate forces at Charleston, with instructions to perfect preparations for reducing Fort Sumter. Anderson was now in danger of being starved out and, in accordance with promise given, Gov. Pickens was informed 8 April by a special messenger sent by President Lincoln, that an attempt would be made to land provisions, and provisions only, at Fort Sumter. Beauregard notified the Confederate government, and received orders 10 April to

demand the evacuation of the fort, and to reduce it if refused. The demand was made at noon of the 11th. Anderson refused, but made the casual remark to the messengers carrying Beauregard's demand that, if left alone, he would be starved out in a few days, and Beauregard, "to avoid effusion of blood," asked when he would be ready to leave the fort. Anderson said he would evacuate the fort by noon of the 15th, should he not prior to that time receive "controlling instructions" from his government or "additional supplies." The reply was not satisfactory, and 3.20 A.M. of the 12th Anderson was notified that fire would be opened within an hour. At 4.30 A.M. the signal-gun was fired from Fort Johnson on James Island; all the batteries opened fire; Anderson replied deliberately; in 24 hours 2,500 shot and shell struck the fort or fell inside of it; the barracks were burned and the fort much damaged; the relieving fleet could not land; and on the afternoon of the 13th terms were arranged under which, on the afternoon of the 14th, Anderson saluted his flag and, with drums beating and colors flying, marched with his garrison out of the fort, was conveyed to a steamer, and sailed for New York. During the bombardment not a man was killed on either side.

When Fort Sumter fell into Confederate possession it had 78 serviceable guns. Additional guns were mounted in it and it was well garrisoned. The Union authorities sunk a number of old whalers filled with stones in the main channel of Charleston harbor to close the port to blockade-runners, and a blockading force was maintained off the harbor; but it was not until 7 April 1863 that any serious operation was attempted against the fort. Then Dupont, with nine ironclads, made an unsuccessful attack upon it. One of the ironclads, the Keokuk, which had approached nearest to the fort, was struck 90 times, and so much injured that she sunk off Morris Island, and her armament fell into the hands of the enemy, while the others withdrew after an engagement of 40 minutes, most of them being considerably disabled by the fire of the 69 heavy guns brought to bear upon them. The fleet fired 151 shots, not more than 34 of which struck the walls of the fort. Sumter discharged 810 shot, Fort Moultrie and other batteries 1,399, in all 2,209, of which 520 struck the different vessels. It had been expected that the fort would be reduced to a pile of ruins before the sun went down, but the result convinced the Union authorities that the fort and adjoining works could not be reduced by a purely naval attack.

It was now determined that Fort Sumter and Charleston should be taken by combined land and naval attacks, the land attack being by way of Morris Island, the capture of the batteries there, and the establishment of batteries to reduce Fort Sumter. For this purpose Gen. Gillmore was selected. He landed on Morris Island 10 July, made two unsuccessful assaults on Fort Wagner, 11 and 18 July, and then concluded to attempt the destruction of Sumter from ground already in his possession, so that the fleet could enter the harbor and command Charleston. (See FORT WAGNER.) A sufficient number of breaching-guns were in readiness 16 August; fire was opened on the 17th, and on the 24th Gillmore reported the practical demolition of the fort. From 18 guns he had thrown 5,009 projectiles, weighing 552,683 pounds, of which 4,147 struck the fort. Before daylight 23 August five monitors approached to within about 800 yards of the fort and opened fire, which was kept up until 6 A.M. Confederate officers now held a council, and the proposition was offered to abandon the fort, but as a matter of sentiment it was resolved to hold it. On 30 August Gillmore resumed fire, dismounting the remaining barbette guns and leaving but one casemate gun serviceable. As a means of defense against the fleet the work was entirely useless, and it was held merely as an infantry outpost. On 2 September six monitors opened fire on it, but it remained silent, not a single gun being in working order to reply. Early on the morning of 7 September, after the abandonment of Fort Wagner, Admiral Dahlgren demanded the surrender of Fort Sumter, which was refused. Meantime the Confederates were removing the guns from the fort and placing them in other parts of the harbor. During the night of 8 September a naval force of about 400 men, under Commander F. H. Stevens, atempted to carry the fort by assault. It was then defended by about 450 men, under command of Maj. Stephen Elliott, Jr. Stevens' men were in boats, and when towed within 800 yards of the fort the boats were cut loose and rowed for the fort, on approaching which they were met with a fire of musketry; as the men landed, hand-grenades and shells were thrown upon them; and simultaneously, at a signal from the fort, all the Confederate batteries on James and Sullivan islands, with one of their gunboats, opened fire, and the attack was repulsed, all who had landed being killed or taken prisoners. The reported loss was 4 killed, 19 wounded, and 102 captured. On 26 October Gillmore again opened fire with his heavy guns from Forts Wagner and Gregg, aided by the cross-fire of 150-pound rifles on board the fleet, which completed the ruin of the fort, and all aggressive operations for the season against Charleston ended, although a desultory fire was kept up against Sumter during November and December to prevent the remounting of guns. The casualties in the fort from 12 Aug. to 11 Dec. 1863 were 43 killed and 165 wounded. From a tabular statement prepared by an officer in the fort it appears that, from 12 Aug. to 31 Dec. 1863, 26,867 shot were fired at it, 19,808 falling against or into it. On the approach of Sherman's army the fort was evacuated 17 Feb. 1865, and 14 April following the same flag that Anderson lowered in 1861 was raised over it with imposing ceremonies. Consult: 'Official Records,' Vols. I.-XXVIII.; Doubleday, 'Reminiscences of Forts Sumter and Moultrie'; Crawford, 'Genesis of the Civil War'; Gillmore, 'Engineer and Military Operations Against Charleston in 1863'; The Century Company's 'Battles and Leaders of the Civil War,' Vols. I. and IV.; 'Naval War Records,' Vol. XIV.

E. A. CARMAN.

Fort Tot'ten, N. Y., a United States military post, established in 1862 at Willett's Point, on Long Island Sound, near Whitestone.

Fort Wadsworth, wŏdz'worth, N. Y., a United States military post on Staten Island, at The Narrows, in New York Bay. It was established in 1827, and was first called Fort Richmond.

Fort Wagner, a work constructed by the Confederates near the north end of Morris Island, a low, narrow, sandy strip of land, about

3½ miles in length, on the south side of Charleston harbor. It was 2,600 yards directly south of Fort Sumter, to which it was an outpost, and was constructed to hold and control all that portion of the island upon which effective breaching-batteries against Fort Sumter could be established. On the northern end of the Island was Fort Gregg, and the southern end was held by a small force of infantry and artillery. Preparatory to a combined naval and land attack on Fort Sumter and Charleston, it was determined to reduce Fort Wagner and take possession of the entire length of Morris Island, and Gen. Gillmore, an engineer officer of skill, was selected to command the land forces. On 10 July 1863, Gillmore, who had concentrated 6,500 men and secretly placed 47 siege guns and field guns in position on the extreme northern end of Folly Island, attacked the Confederate position on the south end of Morris Island, effected a landing, carried the Confederate batteries of 11 guns, and by 9 A.M. occupied three fourths of the island and pushed his skirmishers to within 600 yards of Fort Wagner. The navy assisted with four ironclads. At daylight of the 11th an attempt was made to carry the fort by assault, which failed, with a Union loss of 172 killed and wounded, and 119 taken prisoners, of whom 40 were wounded. The Confederate loss was 12 killed and wounded. After this failure counter-batteries were established against the fort, and it was determined to attempt, with the aid of the ironclads, to dismount its guns, and either drive the Confederates from it, or open the way to a successful assault. The navy kept up an almost incessant fire upon it, and the land batteries were established at distances ranging from 1,330 to 1,920 yards of it. Soon after midday of the 18th the navy and 41 light guns and siege-mortars opened a furious fire upon the fort, which was continued until nearly all its guns were silenced and its defenders driven into bomb-proofs, when about sunset, after 900 shot and shell had been discharged, Gen. G. C. Strong's brigade of six small regiments, supported by Col. H. S. Putnam's brigade of four regiments, made an assault. As the head of the column left the trenches the guns of Forts Wagner, Gregg, and Sumter opened on it, and as it neared Fort Wagner the Confederates mounted the parapet and poured in such a destructive fire of musketry that the leading brigade was repulsed; but the supporting brigade gained a foothold, which it kept for over an hour, when it was driven back. The Union loss in this second assault was 1,128 killed and wounded, and 389 missing; among the killed or mortally wounded being Gen. Strong and Col. Putnam, John L. Chatfield, and Robert G. Shaw (q.v.). The Confederate loss was 56 killed and 133 wounded.

Gillmore now turned his attention to Fort Sumter (q.v.), which, with the aid of the navy was, by 23 August, reduced to a shapeless mass with almost every gun dismounted or silenced. Meanwhile regular approaches were made against Fort Wagner, thousands of heavy shells were thrown against and into it, and by 26 August the trenches were within 250 yards of it, the intervening space being a flat ridge of sand, scarcely 25 yards wide, and for a great part planted with torpedoes. The Confederates were driven from position behind this flat ridge and the approaches continued until within a few yards of the fort, when the heavy guns of the army and navy opened on it. Final operations were inaugurated 5 September at daylight, and in 42 consecutive hours 17 siege guns discharged 1,411 shells at the work, 1,247 of which struck it, the ironclad New Ironsides joined in the attack, the fort was silenced, over 100 of the garrison killed and wounded, and an assault was ordered for the 7th. When morning came the fort had been abandoned and its garrison, with that of Fort Gregg, had escaped, leaving the entire island with the 25 guns of the two works in Union possession. The Union loss on Morris Island (10 July–7 September) was 381 killed, 1,372 wounded, and 565 missing, an aggregate of 2,318; the Confederate loss was 157 killed, 674 wounded, and 238 missing, an aggregate of 1,069. Consult: 'Official Records,' Vol. XXVIII.; Gillmore, 'Engineer and Artillery Operations Against Charleston, 1863'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV. E. A. CARMAN.

Fort Wal'la Wal'la, Wash., a United States military post, established in 1857, at Walla Walla.

Fort War'ren, Mass., a United States military post on Georges Island, near Boston, established in 1837. During the Civil War it was used as a military prison.

Fort Washington, Md., a United States military post on the Potomac River, near Washington, D. C. It was established in 1815 as Fort Warburton.

Fort Washington, N. Y., the site of a former fort at 182d Street, New York, overlooking the Hudson River. It was built prior to the Revolution and surrendered to the British under Sir William Howe (q.v.) 16 Nov. 1776, after a terrific engagement. The loss of the fort caused consternation throughout the United States. Consult: De Lancey, 'The Capture of Fort Washington' (1877).

Fort Wayne, Ind., city and county-seat of Allen County. Situated in the northeastern part of the state, 102 miles northeast of Indianapolis, upon the Saint Joseph, Saint Mary's and Maumee rivers, confluence of the first two within the city's limits forming the last named. It is notable as a railway center, the following lines passing through or terminating there: Pittsburg, Fort Wayne & Chicago, of the Pennsylvania Railway system; Wabash; New York, Chicago & St. Louis; Grand Rapids & Indiana; Cincinnati, Richmond & Fort Wayne; Lake Shore & Michigan Southern; Fort Wayne, Cincinnati & Louisville; Cincinnati, Hamilton & Dayton. The city is central in a rich and highly developed agricultural region that produces abundant crops of the cereals of temperate climates. Considerable tracts of hardwood timber yet remain in what once was one of the most richly wooded sections of the northwest.

Manufactures.— These cover a wide range and embrace numerous establishments of large magnitude. In the various industries 10,000 operatives were employed in 1903. The manufactures include carwheels, Corliss and other steam engines, boilers, gas engines, gas machinery, iron and steel bars, freight and passenger cars, locomotives, electrical machinery and electrical fittings and fixtures, hosiery.

gloves, caps, oil tanks, organs and pianos, women's garments, road construction machinery, carriages, wagons, washing machines, furniture, paper boxes, lumber, sash, doors, malt liquors, cigars, harness and leather findings and a considerable variety otherwise of products in iron and steel, wood and textile fabrics. The value of the manufactured products in 1903 was $15,000,000.

Municipal Service and Improvements.— The municipality owns and operates the public waterworks system, an abundant supply of pure water being procured from wells bored deeply into the rock, and distributed by means of two thoroughly equipped pumping stations. There is a handsome and substantial city hall and police headquarters and eight modern and thoroughly equipped houses advantageously situated shelter the city fire department. The public buildings in the city are a court-house (county), completed in 1902 at a cost of $1,000,000; United States post-office and court-house; a public library erected at a cost of $100,000 through a donation by Mr. Andrew Carnegie; county jail; high school and manual training school building, completed 1904 at a cost of $300,000, and 15 grammar and ward school buildings, most of which are of very modern construction and beautiful architecture.

Schools and Colleges.— The free-school system maintained by the city embraces a high school and manual training school, a training school for teachers, and 15 ward and grammar schools, together with kindergarten departments. The free-school system is governed by a board of three trustees, elected triennially by the city council, the immediate executive head of the schools being a superintendent elected by the board. There are 6 Roman Catholic parish schools in addition to a high school for boys and an academy for girls; and 6 German Lutheran parochial schools. Concordia College, founded in 1850, is seated in Fort Wayne, and is maintained under auspices of the German Lutheran church. Near the city is an academy maintained under auspices of Catholic sisters, an academy for the higher education of young women. Among other institutions of learning are a college of medicine and surgery, a conservatory of music, a school of art, two business colleges, and a school of oratory, expression and physical culture.

Churches and Charities.— There are 47 religious congregations and 40 church edifices, many of them beautiful and costly examples of ecclesiastical architecture. The congregations are distributed denominationally as follows: Baptist, 2; Christian, 3; Congregational, 2; Episcopal, 2; Evangelical Association, 1; Evangelical Lutheran (English), 3; Evangelical Lutheran (German), 4; German Lutheran, 3; Methodist Episcopal, 5; Free Methodist, 1; African Methodist Episcopal, 1; Presbyterian, 4; United Presbyterian, 1; Reformed (German), 2; Roman Catholic, 7; United Brethren, 1; Baptist Brethren, 1; Christian Science, 2. The city is the see of the Catholic Diocese of Fort Wayne. The city has a central charities organization and many of the religious congregations maintain comprehensive societies for charitable and benevolent work.

Hospitals and Asylums.— There are 4 large hospitals of modern equipment, 1 non-sectarian, 2 under Roman Catholic and 1 under German Lutheran administration. There are 3 orphan asylums, two sectarian and 1 maintained by the county; home for emergencies and a refuge for women. Just beyond the city limits is the State School and Home for Feeble-Minded Youth of both sexes and home for epileptic women.

Finance and Banking.— There are 4 national banks, 3 private banks, 3 trust companies and 6 building and loan associations. The national banks have (June, 1904) a total capital of $1,050,000, total surplus of $771,879 and total deposits of $6,053,992. One of the banks is a government reserve agent. Trust companies have (June, 1904) a total capital of $900,000, total surplus of $105,105, and total deposits of $2,095,835. Private banks have total individual responsibility of $1,000,000.

Parks and Cemeteries.— The total public park acreage of the city is 95.49, distributed as follows: Swinney, 45.24; Lawton, 31.20; Reservoir, 13; McCulloch, 4; Hayden, 1.12; Piqua, .75; Old Fort (site of stockade built by General Anthony Wayne in 1794), .18. There are 5 cemeteries — Achduth Veshalom (Hebrew), Concordia (German Lutheran), St. John's (German Lutheran), New Catholic (Roman Catholic), and Lindenwood (non-denominational).

Government.— The city is governed under a special charter, conferred by the state legislature, which provides for a municipal legislative body of two councilmen from each of the ten wards, chosen biennially, a mayor and city clerk, chosen quadriennially, and a board of waterworks' trustees, chosen biennially. The board of public works, board of public safety, health commissioner and park and street superintendents and city attorney and city comptroller are appointed by the mayor. Council fixes all municipal tax levies and appropriations and has final approval of all contracts and franchises.

Trade and Commerce.— Fort Wayne is an important and flourishing trade centre and has a commerce that embraces extensive wholesale and jobbing operations in dry goods, groceries, light and heavy hardware, drugs, millinery, paper, etc. The total volume of wholesale trade in 1903 had a value of $9,000,000. The total post-office receipts for 1903 were $177,496.

History.— The city takes its name from a fort built on a part of the present site of the city by General Anthony Wayne in 1794. The place, however, had a history that long antedated this. There is evidence that La Salle had visited the locality as early as 1670. It was the site of Ke-ki-on-ga, the "Central City" of the once powerful and warlike Miami Indians. At different times during the seventeenth and eighteenth centuries French and English had military posts at Ke-ki-on-ga. In 1790 General Harmer led an expedition against the Miami City, but was signally defeated in a fierce engagement on the Maumee River within what is now the limits of the city of Fort Wayne. In 1791 General St. Clair in a similar expedition was overwhelmed a short distance southeast of Fort Wayne by the Indians under the famous Miami Chief, Little Turtle. General Anthony in 1794 headed a third expedition against the Indians in the Northwest and after utterly de-

feating them at the battle of Fallen Timbers on the Lower Maumee in Northwestern Ohio, marched to Ke-ki-on-ga and in September of that year built his stockade on an eminence overlooking the confluence of the St. Joseph and St. Mary's rivers. There was no further serious trouble within the Indians until August 1812, when the conspiracy of Tecumseh and his brother The Prophet ensued in a close investment of Fort Wayne and its meagre garrison. The siege was vigorously pressed for about two weeks, when it was raised by a force that had been dispatched to relief of the beleaguered garrison. Fort Wayne at once assumed importance as a trading post and in 1825 the town itself was laid out. Its growth, however, was slow until 1840, when the Wabash and Erie Canal was completed, giving great impulse to growth. In 1840 Fort Wayne, then with a population of 2,145, took rank as a city. Between 1850 and 1860 began the era of railroads, when growth received fresh and powerful impetus and Fort Wayne came to be one of the foremost industrial and commercial cities of the State.

Area and Population.—The land area of Fort Wayne in acres within the corporate limits of the city is 4,041.7, or about 6 1-3 square miles. Pop. (1900) 45,115; (1890) 35,393; (1904, est.) 56,290.

HARRY M. WILLIAMS,
Managing Editor Fort Wayne 'Sentinel.'

Fort William, Canada, town of Algoma District, Ontario, on the Kaministiquia River, 1½ miles from Thunder Bay, 426 miles east of Winnipeg. Fort William was founded in 1805 and named for Hon. William McGillivary. It is at the head of the Great Lakes system of navigation, a terminus of the Canadian Pacific railway, and has splendid shipping facilities. Gold, silver, and iron ore are found in the neighborhood. The Canadian Pacific has expended more than $5,000,000 in the erection of large wheat elevators, which have a capacity of 7,950,000 bushels. Fort William has several churches, a fine new town-hall, high school, central school, public schools, and daily and weekly newspapers. It has iron foundries, machine-shops, flour-mills, and other manufactories. Pop. (1901) 3,633.

Fort William Henry. See COLONIAL WARS.

Fort Worth, Texas, city, county-seat of Tarrant County; on Trinity River, and on the Fort Worth & D., the Fort Worth & R. G., the Gulf, C. and S. F., the Chicago, R. I. & P., the Texas & P., the Missouri, K. & T., Houston & T. C., International & G. N., Saint Louis & S. W., and Red River, T. & S. R.R.'s; about 32 miles west of Dallas. It was organized as a town, under general State law, in 1873, with a population of 1,100; and chartered as city in 1882, with a population of 11,285. The government is vested in and administered by a mayor, nine aldermen, city marshal and assessor, and tax collector, elected by popular vote; city secretary, auditor, treasurer, superintendent of waterworks, chief of fire department, street commissioner, and other subordinate officials elected by the city council. The city owns and operates the waterworks and the street-lighting plant. The city-hall and fire halls are commodious structures of stone and brick. It has over 80 miles of improved streets; 68 miles of sewers, and nearly 100 miles of pipes. There are eight national banks and two trust companies and savings banks, with a capital and surplus of $2,965,353, and deposits amounting to $7,928,577. Fort Worth is the centre of the cattle interests and grocery trade of the State, and of the grain and milling interests of the northwestern portion of the State. Having 11 trunk lines of railway with 16 outlets, it is the greatest distributing point of the Southwest. The flour mills, breweries, packing houses, and foundry and machine works are the principal industrial enterprises of the city. The county court-house is constructed of granite and marble from the Texas quarries. The passenger station is one of the largest and finest in the country in a town of this size. The banking houses, colleges, medical schools, high-school building are costly and imposing structures. Fort Worth has one high-school building, 11 ward school buildings, Fort Worth University, Polytechnic College, Medical School, Saint Ignatius Academy, and the public free library. There are 42 church buildings, representing all denominations. There are also sanitariums, a free kindergarten, Rescue Home, a local Benevolent Home for Children, the Saint Joseph's Infirmary, and the State Masonic Widows' and Orphans' Home. There is one public park of 50 acres, several small parks, and three cemeteries.

The growth of population has been rapid but not unhealthful. The vital statistics show less than nine deaths to 1,000 for a series of years. There are no local causes for disease. It is nearly 700 feet above sea-level, and is fanned by cooling gulf breezes during the summer, making a pleasant and healthful place of residence. Pop. (1890) 23,076; (1900) 26,688; (1903 est.) 45,000.

B. B. PADDOCK,
Fort Worth, Texas.

Forth, fōrth, a river of Scotland, rising on the east side of Ben Lomond, in Sterlingshire.

Forth Bridge, The. See BRIDGE.

Fortifications («to fortify,» precisely following its Latin derivative, is *facere fortis*, «to make strong»), such artificial positions as are required for military use. Primarily, such positions are for defense; but no less important in operations against defensive works already established by an enemy. Two definitions, used in another connection, but officially approved by the late Col. Edward Bruce Hamley, president of the Queen's Staff College, London; by the late William T. Sherman, general of the American army, and by the late Theodore D. Woolsey, president of Yale University, indicate the drift of the subject-matter under immediate notice.

1. «Military Science,» the mother of all such constructive relations, «while that of force, as in all police or other protective law, is founded upon the adaptation of all possible means to meet an impending crisis. The wisdom of the statesmen differs only in degree from that of the ordinary householder, and both alike aim at a wise constraint of offensive elements and the radication of such as are adapted to that end. Hence, to meet the demand adequately, wisely, and successfully, thereby to secure ultimate public safety, is the expressive logic for personal action, municipal action, and military action. The brain-power is banded to various shaftings, and the mental processes differ by virtue of different adaptations, but the prime activities are

the same." The citizen who is to be protected, equally with the technical expert, should be sufficiently interested to become actively sympathetic in whatever relates to the national defense.

2. "Military engineering," as the second preliminary definition, "is the application of mathematics and mechanics to the maintenance, or the reduction of fortified positions, the interposition, or the removal of artificial obstacles to the passage of an army, and the erection of suitable works for the protection of territory or troops." Rival systems of practical military engineering, stimulated by successive inventions, have so multiplied their technical terms, borrowed from many languages as well as from their authors, or local customs, that the ordinary citizen who desires but a suggestive history of that progress would be compelled to have both lexicon and scientific text-book by his side in order to fathom their mysteries.

The origin of artificial defense and the development of primitive types until isolated families or groups of families gradually crystallized into independent and self-supporting nations, are so familiar to the willing reader of general history as to need but brief mention. The defense of the retired domicile from wild beasts and the forays of irresponsible robbers was as distinctly a matter of prime necessity for the head of a family, as for the tiger, the wolf, or the robber, to find in thicket, cave, or mountain fastness, his own protection from pursuit and punishment. The simplicity of weapons of offense and defense harmonized with the demand for artificial protection against violence of every kind. The bow-and-arrow and javelin, with the sling, for long range; and the knife, sword, club, and battle-ax, of stone or metal, for hand-to-hand conflict, required protection from each. The hide-bound protective shield at first, and later, the more impenetrable metallic armor, were but types of the development which gradually evolved the fortification proper, in proportion as weapons enlarged their range of stroke as well as their destructive effect. The shield was, in fact, both the simplest as well as the true prototype of defense against superior force. Under its cover, one man could hold several antagonists at bay. When flanking assailants neutralized its protective value, men, in groups, enlarged its functions, until, by the hollow square, or the solid mass, a phalanx could withstand the onset of many times their number. Their uplifted shields were like a modern bombproof against falling flights of arrows while the men, thus protected, supplied constant reinforcements for those in front who were disabled by ax, sword-thrust, or javelin.

Social Conditions.— The sanctity of the home-domicile was, from earliest times, the basis of its protective and stubborn defense. The Hebrew, the Chaldæan and Egyptian traditions and records, as well as those of Greece and Rome, still later, perpetuated that philosophy; and the ancient German, Goth, Moor, and Briton, through all their feudal, racial, and political rivalries, alike honored precepts thus coincident with the first groupings of families for a common defense.

The "Home, as a Castle," was not merely of British conception, but a vital factor in human happiness and safety. With the gradual accumulation of both numbers and wealth, the protection of the many became the duty of each individual, and the assertal of tribal or national superiority, on the part of the more numerous and powerful, engendered such competitive conflicts that centres of influence exacted more systematic and elaborate national defenses. Excursions against other states, and responsive invasions, were the means employed by ambitious rivals to increase their territorial domain and subject inferior peoples to their dominating control.

By this complex evolution of warring peoples, led by daring spirits, systems of more speedy intercommunication, transportation, and the accumulation of war material, arms and food included, became indispensable to the public safety, until warehouses, detached strongholds, internal citadels, and organized armies were the result. All draft animals and beasts of burden were utilized for attack or defense, so that the horse of the warrior might, in turn, drag the war chariot with its out-reaching scythe blade; and both camel and elephant carried miniature castles upon their backs for archers and spearsmen, mounted above.

Military Conditions.— The fundamental principle in all substantial fortifications has been the effort to ensure a destructive fire upon every available avenue of approach to the place protected, and, with this, to secure such enfilading and cross-fire that no position remained unprotected. Human competition has ever been the same in essence, and where no reliable historic record responds to inquiry, exhumed ruins, memorial tablets, and deciphered hieroglyphics, solve all doubt as to the proposition that military science and military engineering belonged to all human activity, ever the same in principle, and differing only in application and development. The paramount object was, to eliminate disparity in physical strength and enable the few to resist the many. Personal combat at short range came to a limit as people gathered in cities; and breastworks first, and then solid walls, became essential in proportion as the numbers of non-combatants gathered there for shelter and safety.

Illustrations.— The most primitive forms of which the earth retains an outline were oval, or circular, mounds or entrenchments, even before walled towns were constructed, these being more compact for defense of each front, or exposure, by defenders from the centre. More modern defenses, especially against savages, of the blockhouse type, had this peculiar value, and even women could prepare arrows, or load weapons, for defenders who in turn acted in all directions.

Such defenses were upon commanding positions, to guard against surprise, with wood and water always within easy reach. These were transient, and usually against predatory or nomadic peoples, of no greatly superior strength. As populous centres increased, defenses were of stone or brick walls of such height and breadth that large armies could mount their summits and chariots convey men and munitions from one point of defense to another. These were surrounded by a flooded moat, or ditch, and were easily made impregnable against an army of equal force and equipment. Towers at angles of quadrangular defenses, and to protect gates of entrance, exit, or for sallies upon an enemy, were supplied with lifting or draw-bridges, and mines and tunnels were excavated under the ditch itself for more ready surprise

of a careless adversary. Cæsar describes a mine which he advanced beneath both ditch and wall, supporting the wall with timber until he could fill the shaft with dry branches, and upon setting all on fire, the wall crumbled, and he stormed the breach.

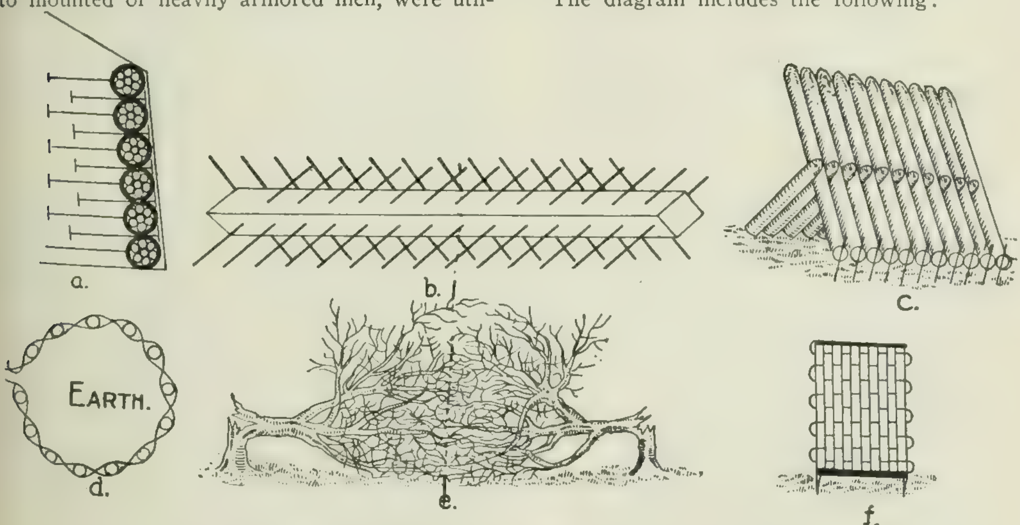
Great machines were made by which to reach engirdling camps, or crush assailants who attempted to bridge, or fill the ditch, and thus gain access to the wall summit by scaling ladders, when unable to force the gates. The catapult and ballista were two of these, which, on the principle of the spring-board and sling, and the increased length of its vibrating arm, the radius of its centrifugal force, would hurl heavy stones at a great distance and send blazing balls of tallow, or pitch, congreve-rocket-like, to destroy a hostile camp.

To meet these mighty forces, corresponding engines of swinging, battering timbers, called "rams" from the device curiously shaped in front, would strike a blow equal to the force of a 30-pound shot, powder-driven. Movable towers, protected by wet hides from fire, were advanced, putting its archers upon a level with those upon the city wall. Titus, at the siege of Jerusalem, brought such towers sufficiently near that, with grouped lances and timbers, he bridged the intervening distance and fought on the city wall itself.

With the increase of territorial domain, subordinate but correlated military engineering had its special province. Territorial boundaries, mountain passes, sharp defiles, river fords, and watercourses, had to be guarded by detached outworks, and these must have close relation, each to the next in order. Swamps, impervious to mounted or heavily armored men, were utilized, and their narrow approaches, or shallow portions, were so fashioned and guarded as to keep assailants from fire-range upon defenders. Outlying summits were made signal stations, both against herds of wild beasts, which in early times were as dangerous to flocks and herds as robbers or hostile invaders were to the inhabitants themselves. Bonfires and flaming torches, as well as a chain of vocal and flag-shaking sentries, became adjuncts to a better external defense. Cæsar had "soldiers who shouted to each other until the alarm reached his camp, through a great distance." The ancient Persians, and later the Scotch and Swiss, were noted for this signal service, but no experience of the kind has such memorial emphasis as that described by the Hebrew prophet Isaiah, who saw in the system of his own people the forecast of a distant future, when "the watchman, from peak to peak, should see eye to eye, and together lift up the voice" in jubilant rejoicing over universal peace to be proclaimed the world around.

Before treating upon fortifications proper, within the limits of this article, there are subsidiary defenses, pro and con, which have antiquity for their use, and the latest of modern battlefields for their equally advantageous application to-day. Their names are familiar as household words, and yet are generally treated as simple types of barbarous usage, before firearms and the sphere of smokeless powder and electricity alike defied stone and iron defenses, and sent destructive missiles beyond human aim and human sight. A few plain illustrations indicate many which had effective use during the American Civil War of 1861–5.

The diagram includes the following:



(*a*) A parapet forming the front of a modern fort, with fascines, behind which earth is packed as they rise, one upon the other, and are locked into the trampled or rammed earth by hoop-poles or common sticks, the fascine being but a bundle of sticks, hooped, or tied with chain or rope.

(*b*) The Chevaux-de-frise, an iron cylinder, or a trunk of a tree, filled with spikes of iron or wood, to which, in case of wood, sword blades, and bayonets may be applied.

(*c*) Inclined and sharpened posts, really an inclined palisade, or stockade material, fastened to the earth, and its parts fastened together by chains or ropes.

(*d*) A basket, open at both ends, made by inserting stakes in the ground in a circle, braiding them by willow, or other flexible green wood, and when filled with earth, forming material for building a parapet, or strengthening a low breastwork.

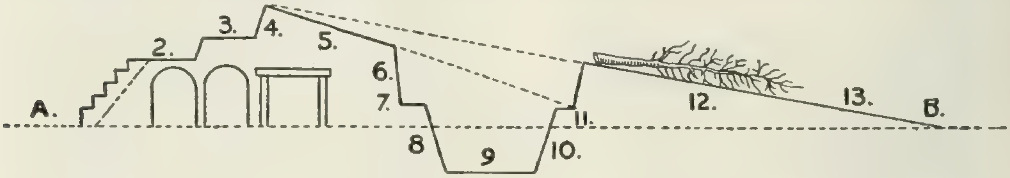
(*e*) A sample of felled trees, across roads, creeks, ravines, and obstructive to approach by horse or foot.

(*f*) A species of hurdles, when horizontal sticks, or poles, vertical or horizontal, are interlaced by willow, brush, or modern wire (as in Cuba), making a fence of stout resistance, and holding assailants under deadly fire.

The farmer's common harrow also was utilized extensively.

All these «obstacles» have been utilized in filling a surrounding ditch to prepare the way for storming the fort itself. Only old soldiers who participated in the American Civil War, or the Spanish war, can realize the extent of their use in actual service, and Cæsar himself, when establishing winter quarters, writes: «Having bastion system, which must under no conditions be neglected in any defense against a superior force.

The Bastion.— The *profile* thus noticed obtains throughout the fort, even when it assumes other forms than that of the simple quadrangle. The *pentagon* and *hexagon* have generally been



A.— B. Level of parade ground, occupied by buildings and by bomb-proof magazine and hospital, so far as the same are not included in chambers beneath the parapet.

(1) The interior slope of the parapet, on a slight incline for easy ascent, or with steps, and these broken at intervals for entrance to chambers beneath.

(2) Level ground, or platform (*terre-plein*), for troops supporting guns.

(3) A step (*banquette*) for gun.

(4) Parapet.

(5) Exterior slope of parapet.

(6) A facing of wood, or masonry, or of *fascines* linked into the earth as it is built (see OBSTACLES, *a*), to hold the parapet in place, and called the *revetment*.

(7) A narrow shelf, path, or *berme*, between parapet and ditch.

(8) The side of ditch next to parapet, *scarped* down at an angle, and therefore called the *scarp* or *escarp*.

(9) The ditch itself, and faced with masonry in permanent works.

(10) The opposite side of the ditch, and therefore called the *counter-scarp*.

(11) A path, or border (*berme*), commanded by rifles from the parapet and used for defending the interior slope of the *glacis*, and for sallies through openings outward, or beneath, and called the *covered way*.

(12) The superior slope of the covered way, called the *glacis* because of its smooth descent to the general surface without the fort.

(13) *Abattis*, felled trees, with shortened and sharpened branches, directed outward, with the butt securely fastened at head of the *glacis*.

cut young trees and bent them, by means of their numerous branches extending on the sides, and the quick briars springing up between them, made these hedges present a fortification like a wall, through which it was not only impossible to pass, but even to penetrate with the eye.» It will be noticed, later, that at the battle of Franklin, Tenn., during the Civil War, prickly osage-orange was a material factor in a successful defense.

Fortifications Proper.— Impregnable fortresses no longer exist. All along the trend of history the term has been fanciful and merely relative. Even Gibraltar, as an isolated fortress, aside from its political and moral force, has its military value as a well located rendezvous for troops and shipping, and the theoretical guardian of the passage from the Atlantic to the Mediterranean Sea. Of this passage, it has no supreme control, without a sufficient naval contingent. In all other respects, it simply defends itself, with no interior at its back, and when without control of the sea, by fleets, imprisons a valuable garrison. In modern times the stationary must yield to the mobile. The art of destruction is more potent and far-reaching than the skill of man to preserve his own workmanship.

Reference has been made to towers, as well as walls, and even after the invention of gunpowder, systems of defense, as well as isolated forts, had their progressive development, in which the United States followed European antecedents and the progressive systems of one general type until the Crimean war largely revolutionized modern practice. A single profile of a cross-section of defenses, as matured during more than two centuries, is sufficient for this article, with an accompanying sketch of the used, leaving to the province of a simple *redoubt* the simpler outline of defense. Very early *projections* were *built out* from these fortified positions, at their angles, hence their name, *bastion*, to give a wider range of *outward* fire, as well as a more direct *flanking* fire, along the walls covered by these projections. These walls were called *curtains*. The containing lines of the salient angle were called *faces*, and the lines connecting the faces with the main wall were properly called *flanks*.

Before these curtains, or main walls, minor defenses were added, whether *ravelin* or *teneille*, and these might be again covered by ditch and glacis, subordinate to but protected by the superior fire from the main position. A diagram of the simple bastion, similar to those in use around Washington in 1861–5, and common to all modern works, is added.

Inland Positions.— Isolated defensive positions of inferior type have been sufficiently noticed. Their history is common to every mature reader. Transient and movable defenses will be noticed in connection with army movements, although earth defenses already partake of the character once referable only to walls of solid masonry. As against a foreign enemy, the United States has more need of coast defenses than many other nations, as her commercial centres are largely upon the sea; but, as a nation, her capital may be classed with those of other countries, which look to frontier defenses for a substantial protection against foreign attack. But forts, on a frontier, may be ignored, *turned*, *left in the rear*, as when Paris was taken, while idle thousands of her defenders were lost to the national defense. Hence isolated capitals and commercial inland cities must have detached, but closely related outer defenses, beyond the reach

of immediate assault or bombardment by an invading enemy.

During the American Civil War, when internal forces attempted the capital, the city of Washington furnished the best type of a city so assailed; 43 forts and batteries, and 36 additional batteries, mounted 99 rifled cannon in *embrasures* and 25 *in-barbette*, as well as 113 smooth-bore in *embrasures* and 147 *in-barbette*, making a total of 384 guns. But additional platforms were erected and made ready, so that a total of 743 guns could confront any new phases of attack. By direction of Gen. Scott, then in command, the writer was directed to visit all these works during their establishment, and at the time opposing forces were displaying their flag upon Munson Heights, within view from the outer works. The *cordon* of forts, batteries, stockades, block-houses, redans, and bridge-heads was complete.

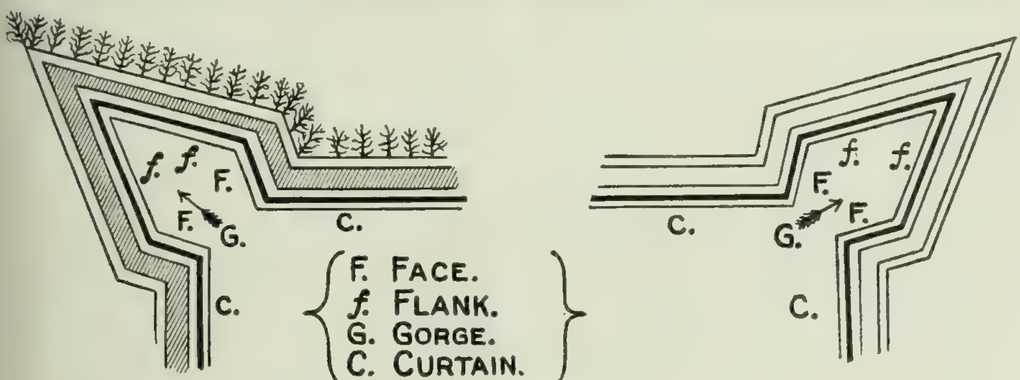
Sea Coast Positions.— Sea coast defenses, from earliest times, have been of massive masonry. Many that still frown innocently upon the American coast, between Boston and New Orleans, are chiefly monumental of obsolete defenses against hostile fleets. Two or three tiers of guns, in as many series of arched chambers, called *casemates*, with a fourth row mounted upon the exposed parapet, or rampart, were expected to cope successfully with the old 120-gun ship-of-the-line. Fort Moultrie, in rude form, in 1776, withstood resistance, with log ramparts, better than with later ones of stone, as in 1861, when sand bags were introduced to support its powers of resistance.

Modern guns, supplied with new explosives, shatter the hardest rock and splinter the toughest timber. The earth alone, and especially sand, will disarm the penetrating projectile of the present day. A single illustration harmonizes with the advent of the new system. Upon the trial of the first 81-ton gun, built at the Woolwich Machine Shops, near London, a mound of sand was erected on the proving grounds against the Thames embankment. Six times a bolt of 1,300 pounds was fired, increasing the powder-charge from 170 to nearly 300 pounds. When the last bolt was dug from the butt, it had entered but 47 feet, 5 feet under the surface of the sand.

Standard tables have long been under consideration to indicate the comparative resistance of earths and gravel, but in all cases, sand, which quickly closes upon what it receives, has been the most obdurate to defy deep penetration. And now, upon the British as well as the American coast, modest mounds or piles of sand present a very indistinguishable target, while, to the nearer view, the abundance of wild grass, daisies, buttercups, and tansy, is its only relieving feature. And yet behind each sand pile, in separate sections, each for a single gun, is to be found the most formidable land defense of modern times. The former «42-pounder» of the casemate and the main battery of a ship-of-the-line, and weighing but 8,750 pounds, is replaced by a gun 40 feet in length, weighing 58 tons, and capable of sending a shot of more than one half a ton, charged by 475 pounds of powder, nearly or quite 7 miles, once each 3 minutes.

A quick release drops the gun below the parapet for reloading. Each battery, however many guns may fall within its control, is operated at will, as if but a single piece were in position. A revetment of solid masonry holds the sand piles in position, and beneath the gun-carriages, which are exposed to the weather, are the necessary passages which communicate with all sections of the battery. Magazines and tackling for handling shot and shell are also under bomb-proof cover, and both placement and independent action of each piece are complete. At suitable distance, but within a practical community of range through adjustable range-finders, sand «pits» for mortars are located. Each mortar revolves upon its own platform, and groups of fours, in closely related pits, can be handled, through signal communication, in connection with the heavy gun batteries, and command a joint delivery of fire upon the same hostile force. As with the gun placements, each mortar pit is independent, in magazine and other appliances, for efficient service.

Floating Batteries.— The battleship as well as the stone fort has also changed character, and become a floating steel fortress. An encircling squadron, in concave formation, can concentrate a weight of metal upon an exposed land defense that cannot be returned by a full equivalent. Other floating batteries, the peer of any, must intervene in support of the land defense, with auxiliary «torpedo boats» and «destroyers.» The contingency of landings to take open batteries, in their rear, is increased by swift steam transportation, and the gravity of defense is more serious in proportion as a nation, having a large coast to defend, has distant, dependent territory, equally demanding a mobile naval force



CLASSIFIED DEFENSES.

for its defense. The submarine boat, the dirigible balloon, and wireless telegraphy, menace modern commercial ports with visitations only less fatal than those of the earthquake and volcano.

Field Fortifications.— This branch of military engineering has a duplex character, but of quite uniform general requisites. They may either constitute the chief defense of a city, or neutralize the numerical superiority of an enemy in the field by wise adjustment of their lines. Two illustrations are suggestive of their value:

On 5 April 1862, when both officers and men were alike inexperiened in operations of war, between large armies and over extended territory, remote from their general base, the Federal army was confronted at Pittsburg Landing, Tenn., by a largely superior force under command of Gen. Albert Sydney Johnson, of the Confederate army. Skirmishing occurred during the day; but Gen. Grant, the chief Federal commander, believing, as he advised his superior, Gen. Halleck, and states in his 'Memoirs,' that there was hardly the slightest possibility of attack, as reinforcements were on the way to his support, failed to entrench. On the following morning, an attack was made in force, driving the Federal army back to the Tennessee River, where the arrival of Gen. Buel's division alone averted a serious disaster. Neither Gen. Grant nor Gen. Sherman committed a similar error of judgment later in the war.

On 30 Nov. 1864 Major-Gen. John M. Schofield retired from Pulaski, closely followed by the two-fold superior army of Gen. Hood. After fighting daily for three weeks, and after frequent rains, leaving with night he marched directly to the city of Franklin, Tenn., where in the bend of the Harpeth River, he gave battle. Between morning and 3 o'clock of that afternoon, when the combined Confederate divisions made an impetuous assault, his wearied soldiers had so utilized the shovel, pick, fence-rails, locust trees, and osage-orange hedges that, behind their shelter, he repulsed the assault, inflicted a loss of nearly 7,000 men upon his adversary, including 12 general officers, in killed, wounded and captured, and safely fell back upon Gen. Thomas, at Nashville, with a loss of but 20 wagons and less than half the casualties of his opponent.

Similar entrenchments had their ancient types in those of Cæsar, who invariably established his camp within a quadrangle surrounded by a rampart of the height of from 7 to 9 feet, with gates on four sides, and sufficiently large in area to include all animals and supplies belonging to his command. On one occasion, seeking winter quarters, he carried a parapet, with ditch, 16 miles, from Lake Geneva to Mount Jura, 15 feet high, and with various small redoubts on the line, so that practically he multiplied his numerical strength three-fold. In modern times, the Crimean war introduced a system of earthworks which withstood a heavy fire before which granite walls had crumbled.

Reduction of Fortified Positions.— Field works, against a fortified position, assume an attitude of counter-defense, as well as a cover for siege or assault. The relative strength of the assailing force belongs to another branch of the military art; but it must be proportionately greater, as the circumference of the investment enlarges, and must prove able, at any vital point, to meet any sally of the garrison, either by numerical superiority, or its equivalent, in artificial defense. Inequalities of the ground, commanding summits, a safe communication with the base of supply, are *strategic* conditions; but all are parts of the position to be assured. After estimating accurately the intervening distance, and at what nearer approach the encircling ditch may be filled, or bridged, for assault, the advance begins. A mortar battery in the rear, or guns in an elevated position, may play upon the intervening space to protect the *pioneers* in locating rifle-pits, while establishing the *first line* of works. The general advance, as thus initiated, is that of a ship beating against the wind, and the zig-zag course adopted borrows its name, *traverse,* from marine usage. Successive files of men dig these traverses, throwing the earth outward to the front, as a cover from fire, and thereby open a way for the advancement of guns, as well as of engineers and troops. A second line, *parallel* with the first, is opened to the right and left, where guns are at once placed in position. A third line, or *parallel,* is so planned as to place the defensive works at the mercy of the besieger. At Yorktown, Va., in 1781, with a river base and no sufficient escape by sea, the effectiveness of the advanced parallel compelled surrender. At Yorktown, in 1862, with works open at the rear for retreat, the scientific soldier in command rightly assumed that the scientific soldier at his front would attempt no assault until his third line was perfected and armed. Hence, he wasted the ammunition of the besieger to the last safe limit, and withdrew his own force in good order, to suit himself.

To this suggestive summary of fortifications, for the unprofessional reader, must be added the statement, that topographical and geographical features largely dominate in matters of attack or defense. *Boundary* lines, whether of mountain or river; interior or coastwise positions; the control of only one or of both banks of a navigable river, give character to defenses and methods for their reduction. Notable illustrations are found in the Dardanelles, the entrance to the Baltic Sea, the Suez Canal, and, prospectively, of vast moment, the Inter-Oceanic Canal in Central America. In proportion as Nature lends her secrets of omnipotent power to the inventive genius of man, so will fortifications change their forms and relations until nations shall control the secret which should inspire all such warlike devices, that of substantial and universal fraternity and peace.

Henry B. Carrington, U. S. A.

Fortifications, Modern Seacoast. The modern science of seacoast fortification wrought marvelous changes during the years intervening from 1893 to 1903. All the great maritime nations expended enormous sums of money to better fortify their coast lines. The United States after 16 years of labor practically completed, during the summer of 1903, the most costly and the most substantial and powerful system of seacoast fortifications in the world. The great improvements made during the latter part of the 19th century in the construction of heavy guns rendered it necessary to revise the system of fortifications formerly in vogue. Iron and steel turrets have taken the place of masonry

on exposed sites, where earth cannot be employed to advantage. These turrets are revolving cupolas with spherical roofs, and in most instances even the largest guns are mounted on disappearing carriages. This is essential since the forts are now called upon to prove their prowess against steel-plated warships.

Great Britain concluded the rebuilding of her forts with iron and steel as long ago as 1880, at a cost of $37,000,000 for nine harbors alone. At Dover, England, solid iron turrets of enormous thickness have been built to carry two 80-ton guns to each turret. Steel cupolas of the Gruson pattern to the number of 28 have been constructed since 1890 in various harbors of Germany, Austria, Belgium and Holland. In 1900 the Italian government placed an order for two of these cupolas to mount two 120-ton Krupp guns each, for the defense of the naval station at Spezzia. The order was conditioned on a test shield or segment of the cupola resisting three shots of the Armstrong 100-ton gun — a test which it successfully withstood, though the same gun had pierced every other known form of construction.

The 20th century fortifications of the United States seacoast finished in 1903 are excelled by those of no other nation in the world. The work was outlined if not actually begun in 1886, when a board of military engineers proposed a system of steel turrets, armored casements, barbette batteries, mortar and floating batteries, and submarine mines. So rapid was the advance of military progress that the original plans were largely changed and modified. The vastness of this work and the great cost can be imagined when America has 5,558 miles of seacoast demanding protection of the most improved kind. Between 1886 and 1903, three fourths of the work was finished, and yet huge rifles and mortars to the value of $15,000,000 were required to complete the undertaking. A modern, high-power coast-defense gun is a huge and elaborate machine, the effective management of which requires great skill. A single 12-inch rifle for one of the modern forts cost $45,000, its carriage $41,000, and the emplacement of concrete in which it stands $60,000, or a total initial cost of $146,000. The total expense for each modern fortress amounts to over $2,000,000. The 20th century fortress is not a walled enclosure as of old, but a hole in the ground, or rather a series of holes called emplacements, built of concrete, and each of them containing one or more guns. No lofty, menacing structure strikes the eye of the observer who approaches the works, but instead there is likely to be rolling greensward with shrubbery, suggesting rather the skill of the landscape gardener than that of the military engineer. The real protection consists of 30 feet of iron and masonry and 30 feet of earth, which form a plane sloping outward, so that any projectile striking is promptly buried or glances off harmlessly.

Fort Warren, on Georgies Island, in the harbor of Boston, Mass., which is one of the most notable fortifications in the world, has an armament of 30 guns and mortars. Several of the guns are 12-inch rifles, but the exact character of the armament is kept carefully secret by the military authorities. The mortars are arranged behind the cannon and are capable of throwing explosive shells for a distance of three miles, and with sufficient accuracy to destroy a vessel at that distance. The projectiles carry an enormous charge of maximite which is three times as powerful as gunpowder. Over 600 of these mortars, each of 12-inch calibre, are distributed among the various coast fortifications. They are a vast improvement on the old-style mortars of cast iron with steel hoops. A mortar of the new, modern type is 13 feet long and weighs nearly 30,000 pounds, and requires a charge of 125 pounds to send its conical projectile on its deadly mission. Weapons of this character have not yet undergone a test in actual war. The modern 12-inch rifle is 40 feet long, weighs 104,000 pounds, requires a charge of 520 pounds, and fires a 1,000-pound projectile a distance of 9 miles, with a velocity, upon leaving the muzzle, of 2,100 feet per second. The 12-inch gun could send the same projectile 14 or 15 miles, if the muzzle was sufficiently elevated, but it would be useless in aiming at an enemy who is beyond the limit of vision, for a ship is out of sight only seven miles away owing to the curvature of the earth. These guns shoot three kinds of projectiles. One is the so-called armor-piercing shot, which is nearly solid, having only a small cavity to contain a high explosive. The second is the armor-piercing shell, which has a larger cavity so as to contain more of the explosive. The third is the torpedo shell, which is in effect a torpedo, having thin walls and containing a large bursting charge of maximite. This explosive is a government secret so far as its composition is concerned. Most of the great rifles are mounted upon disappearing carriages, so they are safe from the fire of the enemy except at the very moment of firing. When its fire has been delivered the gun is lowered promptly below the parapet, and after being reloaded is uplifted again to the firing position.

At Fort Wadsworth, on Staten Island, N. Y., at The Narrows, is located another almost perfect system of coast defense, which is regarded by army officers as a model or typical artillery station. The fortification consists of three separate batteries or groups of guns — one battery of five 8-inch guns and two of two 10-inch guns each, a fire commander's station, three position finding stations, a power and electric plant, a storage battery plant of 60 cells for storing of light and power for the stations when the main power plant is not in operation (for example, if it should be wrecked by a shell), two electric searchlights of 60,000 candle-power beam and wires connecting the electric plant with all parts of the fortification and connecting the stations by telephone.

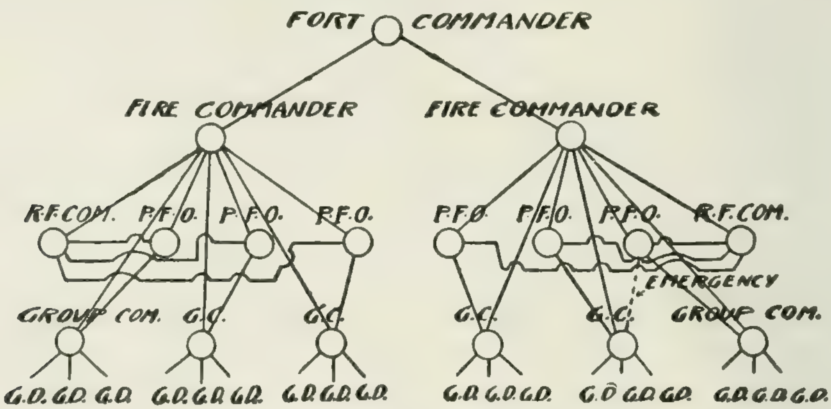
The War Department has prepared the accompanying diagram to illustrate the system of control in the typical artillery station. The diagram is not arranged particularly for the works at Fort Wadsworth. In command of this fortification is a fort commander. Under the fort commander are two fire commanders, each being in control of three groups of guns. Each group in the diagram is composed of three guns, but the number may be more or less. Generally it is the number which one officer can supervise efficiently in action. Each of these officers is called a group commander. Between the fire commanders and the groups of guns is a line of range finders and position finders under a range finder commander and position finding officer. Finally each gun has its firing crew of three, under command of a gun director, who

may be an officer or a non-commissioned officer. The guns are of course behind emplacements. At Fort Wadsworth nature has provided a natural defense in a high hill with a slope terraced to the edge of the water. Behind the hill the fortifications are constructed. On the hill above is the fort commander's station, which controls the approaches to the harbor. The telephone places the fort commander in direct communication with those under his command. The printing telegraph, unknown in the days of the Civil War, is also used in the scheme of communication. The fort commander sitting in his station, communicates his orders to the fire commander by telephone, giving information as to the general scheme of defense. The fire commander communicates with the range finder commander, and then on down the line to the group commander and thence to the three gun directors under him. Under this system the fort commander has perfect control over the guns. If a hostile fleet approaches, he can detect it from his elevated station long before the ships' guns have the fort in range. He can direct the attention of the fire commanders to it, if they have not seen it, and inform them with what guns he wants the firing on it opened. In accordance with a map of the harbor which lies before him he can direct that these guns be turned against a certain target or ship. The fire commanders will transmit his order to the position finding officers, who will indicate the position and range to the group commanders. Then the guns will be aimed and fired. The position finder occupies the most important station, because upon the accuracy of his work depends the effectiveness of a shot which will cost the government $1,000 and possibly cost the enemy $2,000,000 or the value of a modern warship. In aiming the guns allowance is made for the moving enemy and for the force of the wind. The firing is done by stop-watch and every second of time is important.

At the outbreak of the Spanish-American war, the government, owing to the parsimony of Congress, possessed no smokeless powder. In July 1903, millions of pounds of this explosive were safely stored at the various seacoast fortresses. When the American forces took possession of the fortifications at Havana, many of the front sights of the Spanish guns were missing. These cannon were made at Spanish arsenals, and it is supposed that the same defect existed in the guns on the Spanish warships, which may account for the slight damage inflicted upon American ships by the guns of Spain.

The modern system of seacoast defenses of the United States, comprises the following fortifications:

Fort Foster, Maine, on Gerrish's Island, in Portsmouth Harbor.
Fort Gorges, Maine, on Hog Island Ledge, in Portland Harbor.
Fort Preble, Maine, at Spring Point, in Portland Harbor.
Fort Scammel, Maine, on House Island, in Portland Harbor.
Fort Stark, N. H., at Jerry's Point, in Portsmouth Harbor.
Fort Warren, Mass., on Georgies Island, in Boston Harbor.
Fort Strong, Mass., at Long Island Head, six miles from Boston.
Fort Banks, Mass., at Grover's Cliff, near Boston.
Fort Adams, R. I., on Brenton's Point, near Newport.
Fort Greble, R. I., on Dutch Island, Narragansett Bay.



ARRANGEMENT OF FORT BATTERY.

Diagram designed by the War Department.

Fort Wetherill, R. I., on Conanicut Island, Narragansett Bay.
Fort Hamilton, N. Y., at The Narrows, New York Harbor.
Fort Lafayette, N. Y., at The Narrows, New York Harbor.
Fort Michie, N. Y., on Great Gull Island, 12 miles from New London, Conn.
Fort Tompkins, N. Y., on Staten Island, at The Narrows.
Fort Wadsworth, N. Y., on Staten Island, at The Narrows.
Fort H. G. Wright, N. Y., on Fisher's Island, entrance to Long Island Sound.
Fort Carroll, Md., at Seller's Point Flats, Patapsco River.
Fort Howard, Md., at North Point, Patapsco River.
Fort Smallwood, Md., at Rockpoint, 10 miles from Baltimore.
Fort Hunt, Va., Potomac River.
Fort Washington, Md., Potomac River.
Fort Moultrie, S. C., on Sullivan's Island in Charleston Harbor.
Fort Sumter, S. C., in Charleston Harbor.
Fort Oglethorpe, Ga., at Savannah.
Fort Pulaski, Ga., on Cockspur Island, Savannah Harbor.
Fort Taylor, Fla., at Key West.
Fort Barrancas, Fla., near Pensacola.
Fort Pickens, Fla., on Santa Rosa Island, near Pensacola.
Fort Gaines, Ala., on Dauphin Island, in Mobile Bay.

Fort Morgan, Ala., at Mobile Point.
Fort St. Philip, La., 65 miles below New Orleans.
Fort San Jacinto, Texas, near Galveston.
Fort Rosecrans, Cal., at San Diego.
Forts Miley, Baker, and Winfield Scott, Cal., in San Francisco Harbor.
Forts Casey, Columbia, Lawton, Walla Walla and Wright, Wash., in Puget Sound.

The foregoing are the new-type fortifications and in addition to these there are nearly 100 other forts along the Atlantic and Pacific sea-coasts, not yet remodeled or equipped with the modern appliances of warfare. See ARMY OF THE UNITED STATES; ARTILLERY; MILITARY POSTS, U. S.

Fortiguerra, Niccolo, nē-kō-lō' fŏr-tē-gwā'rä, Italian poet and prelate: b. Pistoia 7 Nov. 1674; d. Rome 17 Feb. 1735. A prelate at the court of Pope Clement XI. In his epic poem 'Ricciardetto,' so-called from one of the Paladins of Charlemagne, he wished to show that it was easy to imitate Ariosto. He wrote the first canto of this poem in one night, and continued it to 30 cantos. It appeared (1738) under the name of Carteromaco, which had been assumed by the author during his life. Its principal excellence consists in the description of situations. His short poems and sonnets are to be found in different collections of Italian poets.

Fortu'itism (Lat. *fors,* chance), a doctrine or theory of causation which denies the existence of a final end or object in the course of things. Such a doctrine in the domains of nature results in theories such as that of Darwin, who has been charged with denying design in the changes and developments of organized creatures, that is, the design of a single controlling mind, namely, of a supernatural creator. The opposite to fortuitism is teleology (q.v.), which is the theory of a final end or object in the processes of nature and history, as resulting from the plan or scheme originating in the mind of the Supreme Being.

Fortu'na (Gr. Τυχή), the goddess of success. According to Hesiod she was a daughter of Oceanus; according to Pindar, a sister of the Fates. She had temples at Corinth, Elis, and Smyrna, and worshipped in Italy before the building of Rome, and had a celebrated temple at Antium, in which were two statues, which were consulted as oracles, and gave responses either by signs or by lot. She had also a temple at Præneste, whence she was called *Dea Prænestina.* No less than 26 temples were erected to her in Rome, the first of which was built by Servius Tullius. She is generally delineated with two rudders, with one of which she guides the ship of prosperity, with the other that of misfortune. At a later period she was represented with a bandage over her eyes and a sceptre in her hand, and sitting or standing on a wheel or globe. She is usually dressed as a matron. On a coin of the Emperor Geta she is represented sitting on the earth with her bosom bare, her right hand resting on a wheel, and holding in her left hand, resting on her lap, a horn of plenty.

Fortunate Islands. See CANARY ISLANDS.

Fortuna'tus, a German collection of tales which originated about the end of the 15th century, though many of the tales and legends included in it are of much older date. The substance of the book is that Fortunatus and his sons after him are the possessors of an inexhaustible purse of gold and a wishing-cap, which however, in the end, prove the cause of their ruin. The moral is that worldly prosperity alone is insufficient to produce lasting happiness. The oldest printed edition of the book now extant bears the date 1509. Later German editions mostly bear the title, 'Fortunatus, von seinem Seckel und Wunsch-hütlein.' It has been reprinted in the third volume (1846) of Simrock's 'Deutsche Volksbücher.' Versions of the story have appeared in French, Italian, Dutch, Danish, Swedish, and even Icelandic. The first to dramatize the subject was Hans Sachs, in 'Der Fortunatus mit dem Wunschseckel' (1553), after whom comes the English Thomas Dekker, with his 'Pleasant Comedie of Old Fortunatus' (1600), a work which made its reappearance in German about 1620. The most poetical edition of the story is that given by Tieck in his 'Phantasus' Consult Schmidt, in Ersch and Gruber's 'Encyklopädie' (Sec. 1, Vol. XLVI.).

Fortune, Robert, English author and botanist: b. near Berwick-on-Tweed, England, 1813; d. Scotland 16 April 1880. He learned gardening in early life, and gained a position in the botanical garden at Edinburgh. In 1842 he was appointed collector of plants for the Botanical Society of London in northern China. He published the results of his inquiries in his 'Three Years' Wanderings in the Northern Provinces of China' (1853). In 1848 the East India Company engaged him to visit China to compare the qualities and commercial value of different kinds of tea. He visited the East several times afterward and published an account of his numerous botanical discoveries in 'Two Visits to the Tea-countries of China' (1852); 'Residence Among the Chinese, Inland, on the Coast, and at Sea' (1857); 'Yedo and Peking' (1863).

Fortune Bay. By the fisheries treaty of 1871 with Great Britain (see FISHERIES QUESTION), the American fishermen were granted equal rights on all British coasts. The Newfoundlanders were very jealous of this intrusion on their fishing grounds, and in 1878 the Fortune Bay fishers attacked and drove away some Gloucester vessels. Demand was made on Great Britain for damages, and £15,000 was ultimately paid.

Fortune-telling, predicting the future of an individual, by means of signs or indications noticed by the fortune-teller. Chiromancy is the art of reading the lines or wrinkles on the palm of the hand, as indicative of the future for the person so marked. Necromancy is the art of consulting the dead about the future. In chartomancy playing cards are supposed by their suit or denomination when turned up after being dealt out, to reveal coming events. The ancient astrologer used to decide from the stars the good or bad fortune of an individual, the hour and day of whose birth was taken as data in calculating the planetary conjunctions on which the horoscope was based. In every great city, even of the modern world, there are hosts of people who make a profession of fortune-telling, and there are many more who are credulous enough to believe in their pretensions. The law does not recognize the power of anyone to foretell the future, and the deluded victim of such charlatans, who has paid the wizard for a supposed revelation of the future, can bring the latter to justice for obtaining money on false pretences. In the ancient world there was a

strong belief in fortune-telling, or the power to predict the future. At Rome the government appointed official fortune-tellers of the state, who from the flight of birds or the appearance presented by the entrails of sacrificial victims made calculations as to coming events. The oracles of Delphi and Dodona were consulted by the wisest and best pagan Greeks. At Rome fortunes were told, or believed to be told, by Fortune herself in her temple at Antium. The literature of the Middle Ages is full of allusions to fortune-telling, which also played a part in the fiction and drama of all countries up to the middle of the 19th century. The belief in witches, wizards, and fortune-tellers has utterly disappeared among educated people, as fortune-telling has disappeared from literature. This results, to a large extent, from the advances made in physical science, the clearer views which prevail concerning causation, and the limits of human experience. Rationalism, in its newest form of agnosticism, has likewise cleared the intellectual atmosphere, and made delusion and imposture less and less able to obtain a footing or exercise an influence over sane minds.

Fortunes of Nig'el, The, an historical novel, with scene laid in the London of James I., published by Sir Walter Scott in 1822. The introduction to this work contains interesting self-criticism by the author.

Fortuny y Carbo, Mariano, mä-rē-ä'nō fōr-too'nē ē kär'bō, Spanish painter: b. Reus near Barcelona 11 June 1839; d. Rome 21 Nov. 1874. He studied at Madrid, traveled in Morocco, and settled at Rome, where he became the centre of a school of artists in revolt against over-study of the "masters." In 1866 he went to Paris, where his pictures, mostly genre subjects from Southern and Oriental life, had a great success. Among the best known are: 'A Spanish Marriage'; 'A Fantasia at Morocco'; 'The Academicians at Arcadia'; 'The Seashore at Portici.' The Metropolitan Museum of New York contains his 'Lady in Black,' and 'Camels at Rest,' and many other pictures of his are contained in public and private American art collections. He was also known as an able etcher. See Lives by Davillier (1875), and Yriarte (1886); Muther, 'History of Modern Painting' (1890).

Forty, a number that has sometimes been regarded as peculiarly significant. The idea may have originated with readers of the Bible, who notice that Moses was 40 days on the mount: Elijah was 40 days fed by ravens; the rain of the flood fell 40 days, and another 40 days expired before Noah opened the window of the ark; 40 days was the period of embalming; Jonah gave Nineveh 40 days to repent; our Lord fasted 40 days. He was seen 40 days after his resurrection, etc.

The weather on St. Swithin's Day portends, as it is foul or fair, 40 days' rain or dry weather; a quarantine extends to 40 days; 40 days, in the old English law, was the limit for the payment of the fine for manslaughter; the privilege of sanctuary was for 40 days; the widow was allowed to remain in her husband's house for 40 days after his decease; a knight enjoyed 40 days' service of his tenant; a stranger at the expiration of 40 days was compelled to be enrolled in some tithing; members of Parliament were protected from arrest 40 days after the prorogation of the house, and 40 days before the house was convened.

Forty Immortals, The, the members of the French Academy. See ACADEMY, FRENCH.

Forty Thieves, a band of robbers in the tale 'Ali Baba' in the 'Thousand and One Nights.' They dwell in a cave, the door of which opens at the words "Open, Sesame."

Forum (Lat. for a market-place; connected with *foris*, out of doors), the open space in the centre of a city, in Roman times, where the people assembled, as on common ground, for amusement or the transaction of business. Here elections were held; here were the public buildings, civic and administrative. Included in the forum was the comitium, with its tribunals for the orators who addressed the people. The *curia* or senate house stood, with other buildings, on the forum; and between the public edifices stretched lines of shops or *tabernæ*.

In the days of the kings and under the early republic there was but one forum in each city, small or great. In this open space all public business, political and legal, and all mercantile transactions were carried on. Dramatic representations, exhibitions of gladiators, combats of wild beasts and horse races also took place in the forum. The single forum eventually gave place to two forums, one of which was given up to law administration and politics, and the other to mercantile traffic. Eventually, each important commodity had its own forum. There was the *forum boarium*, cattle market; *forum suarium*, hog market; *forum olitorium*, vegetable market; and *forum piscarium*, fish market. The trade shops, as of gold- and silver-smiths, saddlers, blacksmiths, tinsmiths, money-lenders, booksellers, etc., were ranged round these fora, or occupied streets adjacent to them. The temples that edged the forum at Rome, like the mediæval cathedrals, were sometimes used for secular purposes. Thus, the senate often held meetings in the Temple of Concord, while the Temple of Saturn was used as state treasury, and was also the depositary of public archives, before the erection of the Tabularium. There are a great many ruins which enable us to gain a fair idea of the fora of other cities beside Rome. The fora at Pompeii are as follows. The principal forum; 450 feet from north to south: in its north side was the Temple of Jupiter, the Basilica, or law court, and the temple of Apollo; on the west and on the east side the *macellum* (meat market), the *senaculum* or curia, the Temple of the Genius of Augustus, and the *Scholæ* or corporation building. The triangular forum, *forum triangulare*, contained a Doric temple to the south, and an Ionic portico at the entrance.

In the open spaces of the forum were set up many statues of distinguished men. Even in the days of the republic it was necessary to order the clearing out of such statues, together with crowds of altars, arches, and memorial columns which blocked up the place.

The forum par excellence was of course the original Forum Romanum. It was situated in the hollow between the Palatine, Capitoline and Quirinal hills. The early tribes met on this common and neutral ground. Under the Tarquins the consolidation of the tribes is suggested by the completely adorned and enclosed appearance of the Forum. The Temple of Saturn

appeared in 497 B.C., that of the Dioscuri in 484 B.C., that of Concord in 367 B.C. The first court-house, Basilica Porcia, was not built before 184 B.C.; three more were built later, and it was this increase of buildings that occupied so much of the vacant space that the fish, meat, hog, vegetable and other markets were obliged to retire to other quarters of the city.

Julius Cæsar was the first to add special forums to those already in existence, and his Forum Julium was followed by the Forum Martis of Augustus, sometimes called Forum Augustus. Then came the Forum Pacis of Vespasian, the Forum Transitorium of Domitian and Nerva, the Forum Trajani of Trajan. These all lay side by side, north and east, with the Forum Romanum. The Forum Julium had in its centre a temple of Venus Genetrix, the patron goddess of the Julian gens round which it formed a sort of sacred precinct. The Forum Augustum was dedicated to Mars and in it was situated the Temple of Mars Ultor. This building was flanked by two triumphal arches, and Cæsar had intended that it should commemorate, with appropriate statues, the extension of Roman dominion. The Forum Nervæ was dedicated to Minerva and contained her temple. As the main thoroughfare through this district of the city crossed this forum it was commonly known as Forum Transitorium. The most gorgeous architectural group in the imperial city was exhibited in the Forum Trajani, which had its own special Basilica, like the great forum. It was entered by a triumphal arch, surrounded by a double colonnade; an equestrian statue of the emperor stood in the centre, flanked on each side by a half circle. The Library, Column and Temple of Trajan completed the cluster of marble structures.

The appearance of the Forum Romanum during the last days of the empire may be described as follows: Looking toward the Capitol the spectator would see the Temples of Concord, of Vespasian, and the Dii Consentes. The Temple of Saturn stood between the slope of the Capitol and the Vicus Jugarius. Beside it was the Arch of Tiberius, near that of Septimius Severus. Between these two arches were the rostra. The political buildings stood on the farther side of the arch of Severus. Here was the Senate house or the Curia, while the Temple of Janus rose side by side with the Basilica Æmilia. On the south and opposite side was the vast Basilica Julia, and the beautiful Temple of the Dioscuri. East from this group of buildings was an open space occupied by the Temple of Julius, side by side with which was the triumphal arch of Augustus, and beyond these is the most interesting tract of the old forum, the centre of antique and primitive Roman religion. The Shrine of Vesta, the Temple of Antoninus and Faustina, the Templum Urbis made up a magnificent range of noble and solemn structures, and we are reminded also that at this point once stood the arch of the Fabii at the opening of the ancient Via Sacra.

The invasions of the Goths did not bring much destruction upon the forum. It was in the 11th century that the buildings were devastated at the sacking of Rome (1084), when Gregory VII. was delivered from the Castle of San Angelo by Duke Guiscard. The rarest monuments of the antique world were employed as fortresses. The 16th century witnessed the antiquarian curiosity and reckless vandalism of the Renaissance. The Forum of Cicero and Augustus became a wilderness with only a few isolated columns to mark the site of temples or palaces. Under the learned and liberal Pius VII. the relics were preserved from further destruction and the archæologist Carlo Fea then began those excavations which have been continued by Lanciani.

Bibliography.—Jordan, 'Topographie der Stadt Rom im Alterthum' (1871); Middleton, 'The Remains of Ancient Rome' (1892); Nicholas, 'The Roman Forum' (1877); Lanciani, 'Ruins and Excavations of Ancient Rome' (1897); Boni, official report of excavations, 'Notizie degli scavi' (1899 et seq.); Platner, 'Topography and Monuments of Ancient Rome' (1904).

Forum Ecclesiasticum, a church tribunal or court. It is either internal or external — *Forum Internum, Forum Externum.* The *Forum Internum* is what is known as the tribunal of penance, the confessional, where the penitent is both accuser and accused; and the confessor is the judge who condemns or acquits or pardons, and exacts satisfaction for wrongs and reparation of injury done to others whether in reputation or property. The *Forum Externum* is any ecclesiastical tribunal outside of the sacrament of penance that is concerned with church government. What are the sanctions by which the judgments of the Church's tribunals are enforced? Has the Church the right to inflict temporal pains and penalties on offenders against her laws? That the Church does possess such power is the teaching of the Church herself: the doctrine which declares she does not possess it has been explicitly condemned. The proposition that "the Pope or the whole Church collectively cannot punish any man, however wicked he may be, with a coercive penalty" unless the civil power gives them authority to do so, is condemned by Pope John XXII., and a similar proposition was condemned by Pope Pius VII. in the bull *Auctorem Fidei:* one of the propositions condemned by Pope Pius IX. in the *Syllabus* (1864) declared that "the Church has no power to employ force." In proof of the necessity of such power in the Church, the case of a bishop is cited who teaches heretical doctrine: has not the Church, it is asked, power to depose him; or must the matter go before a tribunal of the civil power? It is held that to make such resort to the secular courts necessary is to render the Church powerless to execute her divine commission, and to make a civil judge the judge of a purely ecclesiastical cause. On the ground of the canon law the Church has the right in herself "to inflict stripes, to impose fines, to imprison in a monastery" offenders against her laws; in short, to impose all penalties short of the effusion of blood, *citra sanguinis effusionem,* or its equivalent. Practically, the power of the Church at present is confined to the infliction only of her spiritual penalties, and these only when they do not in any degree directly or indirectly impair the civil rights of the person who incurs the spiritual censures; when they do so trench on his civil rights, the person has recourse to the secular courts. Thus in this country cases are often brought into the civil tribunals of rectors of parishes or pastors of churches who have been deposed by bishops or

other ecclesiastical superiors; and courts find it within their competence to decide whether the act of the superiors has been done in entire conformity with the constitution and laws of the religious body concerned, and the civil and contractual rights of the complainant.

Forward, Walter, American statesman: b. Connecticut 1786; d. Pittsburg 24 Nov. 1852. He studied law and was admitted to the bar in 1806. In 1822 he was elected to Congress; and in 1841 was appointed by President Harrison first comptroller of the treasury, and was reappointed by President Tyler in September of the same year. On retiring from the cabinet in 1843 he resumed law practice. In 1849 he was appointed *charge d'affaires* to Denmark, but resigned in 1851.

Forwood, William H., American military surgeon: b. Delaware 7 Sept. 1838. He was graduated at the medical department of the University of Pennsylvania and at Georgetown University, Washington, D. C.; entered the regular army as an assistant surgeon in 1861, and served throughout the Civil War. He also served in many Indian campaigns; was surgeon and naturalist with the exploring expedition through Wyoming, Montana, and Idaho, in 1883; located military hospitals in Savannah, Ga., and the camp hospitals in Montauk Point, during the Spanish war; and was appointed surgeon-general of the army with the rank of brigadier-general in 1902.

Foscari, Francesco, frän chĕs'kō fŏs kä'rē, doge of Venice: b. 1372; d. Venice 1 Nov. 1457. In 1416 he was named procurator of St. Mark's, and in 1423 was elected doge. His son Giacopo, being accused of ordering the assassination of a senator Donati, the enemies of the family created such commotion in the state that, unable to clear himself to their satisfaction of the charge, he was banished from the city, the father having to ratify the sentence. Love of his country, and devotion to his wife, compelled the banished Foscari at all hazards to revisit his beloved Venice, where, being discovered by his enemies, he was denounced, again made prisoner, put to the question of the rack, and a second time banished, dying soon after of his wounds, or the torments of his secret punishment, and of grief at separation from his idolized family. The fate of the son had such an effect on the doge that the bereaved father went mad, in which state the enemies of his family compelled him to abdicate. He died three days after in a spasm, upon hearing the bells of St. Mark's announce to Venice the election of a new ruler. Byron has written on the subject a tragedy entitled 'The Two Foscari.'

Foscolo, Ugo, oo'gō fŏs'kō-lō, originally **Niccolo,** Italian author: b. Zante, one of the Ionian isles, 26 Jan. 1778; d. Turnham Green, near London, 10 Oct. 1827. A man of passionate temperament, and withal an ardent patriot, Foscolo was bitterly disappointed when by the Treaty of Campo Formio Venice was given to Austria, and his disappointment found vent in the 'Lettere di Jacopo Ortis' (1802), a sort of political Werther. Becoming finally undeceived as to Napoleon's intentions with regard to his native land, he returned to Milan, where he published in 1807 his best poem, 'I Sepolcri,' a work composed in the spirit of the ancient classic writers, and remarkable for its smooth and polished versification. About this time he wrote a translation of Sterne's 'Sentimental Journey,' and two tragedies, 'Ajace' and 'Ricciarda,' both showing political tendencies. In 1899 he was appointed to the chair of eloquence in Pavia. His inaugural address, 'Dell' Origine e dell' Ufficio della Letteratura,' although full of the same love of classic beauty which marks the 'Sepolcri,' is turgid and affected in style. When in 1814 the Austrians entered Milan, Foscolo withdrew to Switzerland, and in 1816 he went to London. There some of his best writings were published, namely: 'Essays on Petrarca'; 'Discorso sul testo del Decamerone'; 'Discorso sul testo di Dante.' His remains were finally deposited in the Church of Santa Croce, Florence, in 1871. His works and letters were published at Florence in 12 volumes by Le Monnier (1850–62). Consult Lives by Pecchio (1836); Carrer (1842); Artusi (1878); Antona Traversi (1884); and De Winckels (1885–6).

Fos'dick, Charles Austin («Harry Castlemon»), American writer of juvenile books: b. Randolph, N. Y., 6 Sept. 1842. He served in the Union navy in the Civil War from 1862 to 1865. Besides contributions to periodicals, he has published under the pseudonym «Harry Castlemon» over 30 books for boys, among which are: 'The Gunboat Series' (1864–8); 'Rocky Mountain Series' (1868–71); 'Rod and Gun Series' (1883–4); 'The Buried Treasure'; 'The Steel Horse'; 'Jack the Trader'; 'The Houseboat Boys'; etc.

Fosdick, William Whiteman, American poet: b. Cincinnati, Ohio, 28 Jan. 1825; d. there 8 March 1862. He gained some distinction as a poet by a drama entitled, 'Tecumseh.' He also published: 'Malmiztic the Toltec' (1851), and 'Ariel and Other Poems' (1855).

Foss, Cyrus David, American Methodist bishop: b. Kingston, N. Y., 17 Jan. 1834. Having been graduated at Wesleyan University in 1854, he became an itinerant in the New York Conference of the Methodist Episcopal Church in 1857, was pastor at Chester, N. Y. (1857–9), Brooklyn (1859–65), and New York (1865–75). In 1875–80 he was president of Wesleyan University, and in the latter year was elected bishop. He made official missionary tours of the stations of the Methodist Episcopal Church in Europe (1886), Mexico (1893), and India and Malaysia (1897–8).

Foss, Sam Walter, American poet: b. Candia, N. H., 19 June 1858. He has been librarian of the Somerville, Mass., public library from 1898. His published works include: 'Back Country Poems' (1894); 'Whiffs from Wild Meadows' (1895); 'Dreams in Homespun' (1897); 'Songs of War and Peace' (1898).

Fos'sa, or **Foussa,** a large, brown, unstriped carnivorous mammal of Madagascar (*Cryptoprocta ferox*), which has the form of a huge weasel (twice the size of a house-cat), and like a weasel is lithe, active and bloodthirsty. Its systematic place is by no means decided. It is placed by Beddard as representing a distinct sub-family of the civets; while Mivart and Lydekker regard it merely as a genus of civets. Zittel, in view of its dentition and the retractibility of the claws, among other features, re-

gards it as occupying an intermediate place between the civets and the cats, and associated with such composite extinct forms as *Dinictis, Proælurus* and *Pseudælurus*, but classifies it in the *Felidæ*. It is the largest carnivore in Madagascar, and preys chiefly on birds and lemurs.

Fossil Footprints. See ICHNOLOGY.

Fossil Plants. See PALÆOBOTANY.

Fossil Vertebrates. See FOSSILS; PALÆONTOLOGY.

Fossilif'erous Rocks, rocks in which are found embedded the petrified remains, or molds of plants and animals. See FOSSILS; PALÆONTOLOGY; etc.

Fossils, the impressions or remains of plant or animal forms preserved in rocks by natural causes. Fossils supply data, from which the geologist can determine the relative ages of sedimentary rocks. The first man to realize their chronological importance was the English surveyor, William Smith, known as the father of historical geology, although acute observers like Leonardo da Vinci had pointed out long before that fossil shells were not freaks of nature, but had been laid down where found in the sediments of some body of water.

Most fossil remains are of marine types; many are of fresh-water and land-and-water types; comparatively few are of land types. The reason is plain. Animal remains lying on the ground are eaten by animals, or if not eaten, soon decay, and the bony skeleton, if buried by sand or loam, is slowly dissolved by percolating water. Plant remains decay even more rapidly. In water, decay is retarded. Thus mastodon remains have been found in swamps where the animals were occasionally mired, but of the infinitely greater number of mastodons that died on drier ground no trace is left. Old lake beds are frequently rich in plant and animal remains. Fishes, insects, birds, and land animals, and the leaves, flowers, and fruits of trees are preserved in the fine-grained shales or the sands and clays of the lake deposits in several western States. In old swamps, plants formed thick masses of vegetable matter, now turned to coal, imprints of leaves and stems being common in the shale overlying a coal-seam. In the sea, conditions are most favorable for the preservation of organic remains, and marine deposits have formed thick and extensive beds. Hence, of all the fossils found, marine types are most numerous. Fossils are preserved in several ways, which may be classified under three heads. (1) Some of the original substance may be preserved, as the carbon in a leaf, or the bone or shell of some animal. (2) All the original substance may dissolve away, but its shape may be preserved. This may happen in two ways: (*a*) the external form may be preserved in the sediments, forming a mold, or (*b*) the internal form may be preserved, forming a cast. A mollusk dies; its soft parts decay; the interior of the shell fills with sand or ooze; the shell is deeply buried. The sediments consolidate; the calcareous material of the shell may dissolve; but both its external and internal form are preserved. (3) In rare cases the structure of organic remains is preserved by a true petrifaction, the organic substance being replaced, atom by atom, by some mineral compound, like silica or calcium carbonate. A striking illustration of this method of preservation is fossil wood, in which the replacing silica preserves minute details of structure. See COAL; CORAL ISLANDS; GEOLOGY; PALÆONTOLOGY; PALÆOBOTANY.

Foster, Abby (KELLEY), American reformer: b. Pelham, Mass., 1811; d. 1887. She was married to S. S. Foster (q.v.) in 1845. At first a teacher, from 1837 she appeared as a platform lecturer in support of the abolition of slavery, being the first woman to assume this role, and she suffered much harsh treatment from the opposition. After her marriage she traveled and lectured with her husband, and later spoke also in behalf of woman's suffrage and prohibition.

Foster, Benjamin, American artist: b. North Anson, Maine. A pupil in New York of Abbott Thayer, and in Paris of Luc Oliver Merson, and Aimé Morot, he obtained various recognition of his excellence in landscape, including a bronze medal at the Paris Exposition of 1900, and the Webb prize of the Society of American Artists in 1901. Among his works are: 'Mists of the Morning,' for which he received the Webb prize, and 'Night Scene at the Paris Exposition,' purchased by the French government for the Luxembourg Gallery.

Foster, Birket. See FOSTER, MYLES BIRKET.

Foster, Charles, American legislator and cabinet officer: b. near Tiffin, Ohio, 12 April 1828; d. Springfield, Ohio, 9 Jan. 1904. He entered a mercantile career at Rome, now Fostoria, Ohio, and became the proprietor of the largest country business in the State. At the time of the Civil War he was active in the recruiting of troops. In 1870 he was elected to Congress in a district previously strongly Democratic, and in 1872, 1874, and 1876 was rechosen. While in Congress he was for some time a member of the ways and means committee. He was elected governor of Ohio in 1879, and again in 1881, his administration being marked by special attention to the non-partisan management of public institutions. In 1891 he was appointed secretary of the treasury by President Harrison, and in that post he negotiated a loan of $25,364,520 at the unprecedentedly low rate of 2 per cent. Subsequently he was a commissioner on several diplomatic missions of importance and performed his duties with great skill and satisfaction to his government.

Foster, David Skaats, American author: b. Utica, N. Y., 1852. After a common-school education at Utica, he there entered the coal and iron business. His publications include: 'Rebecca the Witch and Other Poems'; 'Elinor Fenton,' a novel; 'Spanish Castles by the Rhine,' and 'Prince Timoteo.'

Foster, George Eulas, Canadian statesman: b. Carleton County, New Brunswick, 3 Sept. 1847. He was graduated at the University of New Brunswick in 1868, studied also at Edinburgh and Heidelberg, was professor of classics and history in the University of New Brunswick in 1872–9, and in 1882 was elected to the Canadian Parliament. In 1885–8 he was minister of marine and fisheries; in 1888–96 minister of finances. Upon his visit to England in 1894 in connection with Dominion finances, he

negotiated a loan of $11,250,000. He was government leader in the Commons in 1895.

Foster, Gilbert, English artist: b. Manchester, England, 9 May 1855. He studied art with his father, a portrait painter, and exhibited his first picture at the Academy in 1876, since which date he has been a yearly exhibitor. Among his paintings are: 'Lingering Light' (1890); 'Birds of a Feather' (1891); 'The Last Faint Pulse of Quivering Light' (1892); 'The Azure Mead' (1895); 'Hush of Night' (1898); 'A Garden of Lyonnesse' (1900); 'A Garden of Memories' (1901).

Foster, Hannah (WEBSTER), American novelist: b. 1759; d. Montreal, P. Q., 17 April 1840. Her published works are: 'The Coquette, or the History of Eliza Wharton,' one of the earliest of American novels; 'The Boarding School' (1796); and 'Lessons of a Preceptress' (1798).

Foster, Henry, English scientist: b. Woodplumpton, Lancashire, 1797; d. Isthmus of Panama 5 Feb. 1831. He entered the royal marines, but after the peace of 1815 devoted himself chiefly to astronomical studies. The gold medal of the Royal Society of Great Britain was awarded him for his services on the Arctic Expedition of Capt. Ross in 1818–19. On 27 April 1828, he sailed on the Chanticleer, as commander of an expedition to determine the direction of the principal ocean currents in both hemispheres. He was drowned while exploring the Chagres River in Panama.

Foster, John, English essayist: b. Halifax, Yorkshire, 17 Sept. 1770; d. Stapleton, near Bristol, 15 Oct. 1843. A Baptist clergyman, self-educated and with an advanced point of view, he contributed to the 'Eclectic Review' regularly as well as delightfully; but his volume of 'Essays' (1805) constitutes his chief title to recognition. Four in number, these compositions are respectively: 'On a Man's Writing Memoirs of Himself'; 'On Decision of Character'; 'On the Application of the Epithet Romantic'; and 'On Some of the Causes by which Evangelical Religion has been Rendered Less Acceptable to Persons of Cultivated Taste.' All are marked by great solidity and depth of thought, combined with a lucidity and nervousness of style which no English author has surpassed. Of the four essays the palm is generally given to that 'On Decision of Character,' though in the opinion of Robert Hall the fourth of the series was the work on which Foster's fame with posterity would rest. As a preacher Foster never succeeded in attracting much attention. His discourses, though solid and philosophical, were of too abstract and unadorned a nature to be readily appreciated by a popular audience. In 1817 he wrote his 'Essay on the Evils of Popular Ignorance, in which he exposed the fearful condition of the masses in the large towns of England, and strenuously urged the establishment of a national system of education.

Foster, John Gray, American military officer: b. Whitefield, N. H., 27 May 1823; d. Nashua, N. H., 2 Sept. 1874. He was graduated at the United States Military Academy in 1846, entering the engineer corps. At the outbreak of the Civil War he was assigned to duty at Fort Sumter and was one of its garrison during the siege. In 1861 he was commissioned a brigadier-general of volunteers; took a leading part in the capture of Roanoke Island in 1862; was promoted major-general of volunteers; and became commander of the Department of North Carolina, defending that region with skill. Subsequently he commanded the Departments of Ohio and Florida, and in 1865 was brevetted major-general, United States army.

Foster, John Watson, American diplomatist: b. Pike County, Ind., 2 March 1836. He was graduated at the Indiana State University in 1855; studied law, and was admitted to the bar in Evansville, Ind. After the Civil War, during which he served in the Federal army with distinction, he was editor of the Evansville *Daily Journal* and postmaster of that city; minister to Mexico in 1873–80, to Russia 1880–1, and Spain 1883–5. He was special commissioner to negotiate reciprocity treaties with Spain, Germany, Brazil, and the West Indies in 1891; and United States secretary of state 1892–3. Subsequently he was the agent for the United States before the Bering Sea Arbitration Tribunal at Paris; participated in the peace negotiations with Japan; and in 1898–9 served as a member of the Anglo-American Joint High Commission. He has published a pamphlet, 'The Alaskan Boundary' (1899), and 'A Century of American Diplomacy 1776–1876' (1900).

Foster, John Wells, American geologist: b. Brimfield, Mass., 1815; d. 1873. He was graduated at Wesleyan University in 1834, and having removed to Ohio, studied law and was admitted to the bar there; in 1837 became an assistant in the geological survey of Ohio; and in 1847 was appointed an assistant to Prof. Jackson in a survey of the region about Lake Superior. The results of this survey, executed in connection with J. D. Dana, appeared in several volumes published by authority of Congress. Foster aided in the organization of the Republican party in Massachusetts, and from 1858 was resident in Chicago, where he made a notable study of the ethnology and palæontology of the Mississippi basin. Among his works are: 'The Mississippi Valley' (1869); 'Prehistoric Races of the United States' (1873).

Foster, Judith Ellen (HORTON), American temperance advocate: b. Lowell, Mass., 3 Nov. 1840. She was married to E. C. Foster in 1869. She studied law and in 1872 was admitted to the State bar of Idaho. In 1870–84 she was superintendent of the legislative department of the National W. C. T. U., and upon the affiliation of the society with the Prohibition party, joined the Non-Partisan W. C. T. U., of which she was president in 1889–93. Her publications include: 'Constitutional Amendment Manual' (1882); 'The American Renaissance.'

Foster, Lafayette Sabine, American statesman: b. Franklin, Conn., 22 Nov. 1806; d. Norwich, Conn., 19 Sept. 1880. He was graduated at Brown University in 1828 and admitted to the bar in 1830; took an active part in Connecticut politics, and was elected to the legislature in 1839, serving several terms. He was elected to the United States Senate in 1854; was president pro tem. of the Senate in 1865; and, after Andrew Johnson became President, was acting Vice-President of the United States. His senatorial term expired in 1867, but on account of his moderate and conservative course in the Senate his re-election was strongly opposed,

and he withdrew his name. In 1870 he was again elected to the State legislature, but resigned in June of that year to take his seat on the bench of the Connecticut supreme court. In 1878 he was appointed a member of the commission to devise simpler forms of legal procedure for State courts, and in 1878–9 was commissioner from Connecticut to settle the disputed boundary question with New York.

Foster, Sir **Michael,** English physiologist: b. Huntington 8 March 1836. He was a surgeon in his native town 1860–6; became prælector of physiology at Trinity College, Cambridge, in 1870, and since 1883 has been professor of physiology at Cambridge. He was president of the British Association in 1899 and was knighted the same year, and has been member of Parliament for London University from 1900. He has published: ‘Text Book of Physiology’; ‘Lectures on History of Physiology,’ etc.

Foster, (Myles) Birket, English artist: b. North Shields 4 Feb. 1825; d. Weybridge, Surrey, 27 March 1899. He began his artistic career as a wood-engraver, executing illustrations for ‘Punch’ and the ‘Illustrated London News,’ and for several volumes of English classics. From 1859 he drew much in water-color, being particularly successful in his presentation of rural life and landscape. Among his subjects in this genre are: ‘Nutting’; ‘Feeding the Ducks’; and ‘Cows in the Pool.’ His works are widely popular in England, where they have been much engraved.

Foster, Randolph Sinks, American Methodist clergyman: b. Williamsburg, Ohio, 22 Feb. 1820; d. Newton, Mass., 1 May, 1903. He was educated at Augusta College (Millersburg, Ky.), entered the Methodist Episcopal ministry as an itinerant in 1837, was transferred from the Kentucky conference successively to Ohio and New York, and was president of the Northwestern University 1857–60. In 1868 he became a professor in Drew Theological Seminary (Madison, N. J.), and in 1872 president of the institution. In the latter year he was also elected bishop, and in 1896 retired from the ministry. Among his publications are: ‘Centenary Thoughts’; ‘Studies in Theology’; ‘Philosophy of Christian Experience.’

Foster, Robert Verrell, American theologian: b. Wilson County, Tenn., 12 Aug. 1845. He was educated at Cumberland University (Lebanon, Tenn.), and the Union Theological Seminary, and from 1877 has been a professor in the former, originally of Hebrew and New Testament Greek, subsequently of systematic theology. Of his publications may be named: ‘Old Testament Theology’ (1890); ‘Systematic Theology’ (1898).

Foster, Roger, American lawyer: b. Worcester, Mass., 1857. He studied at the University of Marburg, Yale, and the Columbia Law School, in 1880 was admitted to the New York bar, and was special counsel to the board of health of New York in 1896–8. His writings include, besides many pamphlets and articles in periodicals: ‘A Treatise on Federal Practice’ (1890–2); ‘A Treatise on the Income Tax of 1894’ (1895).

Foster, Stephen Collins, American song-writer: b. Pittsburg, Pa., 4 July 1826; d. New York 13 Jan. 1864. He was educated at Athens Academy and Jefferson College, Pennsylvania. He composed the music and wrote the words of over 125 popular songs and melodies, among which are: ‘Old Folks at Home’; ‘Nelly Gray’; ‘Old Dog Tray’; ‘Come Where my Love Lies Dreaming’; ‘Suwanee River’; etc.

Foster, Stephen Symonds, American abolitionist: b. Canterbury, N. H., 1809; d. 1881. He was graduated at Dartmouth College in 1838; studied theology at the Union Seminary, became an anti-slavery orator, and was known for his radical methods. His attacks upon the Church for its position in regard to abolition aroused hostility against him, and his practice of interrupting church services was the cause of several mob disturbances. He published ‘The Brotherhood of Thieves: A True Picture of the American Church and Clergy’ (1843).

Foster, Theodosia Toll («Faye Huntington»), American author: b. Verona, N. Y., 1838. She was married to James H. Foster 1869. She was educated at the Oneida Seminary, and was for many years principal of a school at Verona. Her works include a long series of volumes of fiction, such as: ‘Ripley Parsonage’ (1877); ‘What Fide Remembers’ (1885); ‘The Boynton Neighborhood’ (1895); and ‘Lewis Elmore — Crusader’ (1898).

Fosto'ria, Ohio, a city in Seneca County, 35 miles from Toledo, on the Baltimore & O., and Lake Erie & W. R.R.'s. It was named in honor of Charles Foster, governor of Ohio (1891–3), who was influential in building many factories here. Pop. (1900) 7,730.

Fothergill, fŏth'ėr-gĭl, **Jessie,** English novelist: b. Manchester, England, 7 June 1856; d. London 30 July 1891. Her stories show a keen faculty of observation, and include: ‘Healey, a Romance’ (1875); ‘Aldyth’ (1876); ‘The First Violin’ (1878), in which German life is faithfully portrayed; ‘Probation’ (1879); ‘Kith and Kin’ (1881); ‘Made or Marred’; ‘Borderland’ (1886); ‘One of Three’; ‘The Lasses of Laverhouse’ (1888); ‘A March in the Ranks’ (1890); ‘Oriole's Daughter’ (1893).

Fotheringay (fŏth'ėr-ĭn-gā) **Castle,** the site of which was near Peterborough, England, 27 miles northeast of Northampton. The castle to which a melancholy interest attaches as the scene of the imprisonment, trial, and execution of Mary Queen of Scots, was demolished by her son James I. Several of the illustrious Plantagenets are buried in its church.

Foucault, Jean Bernard Léon, zhŏṅ bār-năr lā-ôṅ foo-kō, French scientist: b. Paris 18 Sept. 1819; d. there 11 Feb. 1868. He was editor of the ‘Journal des Débats’ from 1845, in 1854 became physicist to the Imperial Observatory, and in 1855 received the Copley medal of the Royal Society of London for his measurement of the velocity of light. His inventions include a device much used in the employment of the electric light in microscopic and optical researches. He also demonstrated (1851) by means of the pendulum and the gyroscope, the rotation of the earth upon its axis.

Foucault Currents, or **Eddy Currents,** are electrical currents generated by induction within the substance of a massive conductor that is moving in a magnetic field, or which is exposed to the influence of a variable field. If the con-

ductor is filiform, like a wire, no current can be produced in it save in the direction of its length. If a massive conductor be thought of, however, as composed of an infinite number of closed circuits, each composed of a single wire, and all tangled up and then melted into a solid mass, it is evident that (in general) currents will be induced in all of these imaginary circuits when the conductor moves, or when the field to which it is subjected varies. In the actual case the conductor is not composed of wires melted together, but currents are nevertheless generated within it just as though these wires had an actual objective existence. Mathematical equations can in fact be written down, from which it is possible to compute the direction and intensity of the current that is flowing, at any given instant, through any proposed point of a conductor in a known but varying field. Such calculations are seldom made outside of college class-rooms, however, because it is known from the general principle of the conservation of energy that the direction of the Foucault currents is everywhere such as to oppose the change (of whatever sort it may be) which produces them. Hence such currents tend to diminish the efficiency of all motors, dynamos and transformers in which they occur, and designers therefore strive to avoid them so far as possible. In armatures and in transformers, for example, it is customary to laminate the masses of iron that are exposed to changing fields, the individual parts being insulated from one another by air gaps or otherwise, and their surfaces of separation disposed (as nearly as practicable) so as to be perpendicular to the direction in which the Foucault currents tend to flow. In galvanometers, masses of copper are often purposely disposed near the sensitive needle with distinct advantage; for while they do not affect the total deflection of the needle, they cause it to come to rest very quickly after the circuit is broken, the motion of the needle inducing Foucault currents in the copper, which tend always to bring the needle to rest. The energy that is expended in the generation of Foucault currents is transformed into heat, and raises the temperature of the mass within which the currents are flowing. The name refers to the French physicist Foucault, who studied the subject with much care.

Foucault's Pendulum Experiment, a curious and remarkable method invented by Jean Bernard Léon Foucault (q.v.), of showing the rotation of the earth on its axis, by observing a vibrating pendulum, and his experiment goes under the above name. In this experiment a graduated disk is seen to turn, while a pendulum freely suspended maintained its plane of oscillation. If a heavy ball is suspended by a fine wire and set to vibrate like a pendulum, it may easily be shown, either mathematically or by experiment, that the point of suspension, with the wire and ball, may be rotated round an axis, passing along the length of the wire, without interfering with the vibration. In other words, the pendulum will continue to vibrate in the same plane, although the point of suspension be turned round the axis of suspension. It follows immediately from this that if we could suspend a pendulum at the north or south pole and set it vibrating it would continue to swing in the original plane of vibration; and as the earth is turning on its axis, a marked line on the earth's surface would appear to turn underneath the pendulum; or rather, it would seem to an observer, accustomed to feel as if the earth were at rest, that the plane in which the pendulum vibrates turns round relatively to the marked line on the earth's surface. It is easily shown that a similar phenomenon may be observed in any latitude except at the equator; the amount of rotation, however, that the plane of vibration of the pendulum seems to undergo is not so great in low latitudes as in high latitudes; but still in our latitudes rotation takes place to an extent easily observable. The performance of this experiment requires the greatest nicety. The pendulum is suspended on a fine wire, the support of the wire being constructed with great accuracy, so as not to interfere with the vibrations. The motion of the pendulum must be strictly confined to one plane; and, for that reason, in setting it to vibrate the bob is drawn aside and fastened by a silk thread, and when everything has come perfectly to rest the bob is released by burning the silk thread. During its subsequent motion it is protected from currents of air by glass screens. It need scarcely be remarked, however, that this experiment is nothing more than an illustration. Our knowledge of the rotation of the earth, drawn from astronomical considerations, cannot be strengthened by it. This experiment was first made public in 1851, when it was exhibited by M. Foucault before the Academy of Paris.

Foucaux, Marie Filon, mä-rē fē-lôṅ foo-kō, French author: b. 1842. She wrote several historical studies and works of fiction on the Empire and Restoration periods, among them: 'Les belles amies de M. de Talleyrand' (1880); and 'Une intrigante de la Restauration' (1888). Further publications by her include several volumes on Sanskrit literature under the pen-name "MARY SUMMER." Of these the most noteworthy is her 'Contes et legendes de l' Inde ancienne' (1878), crowned by the Academy.

Fouché, Joseph, zhō-zĕf foo-shā, DUKE OF OTRANTO, French politician and detective: b. Nantes 29 May 1763; d. Trieste 25 Dec. 1820. The Revolution, into which he entered with enthusiasm, found him teaching philosophy in Nantes; he became advocate, and was sent to the convention by the department of Loire-Inférieure. Here he was placed on the Committee for Public Education, voted for the death of the king, and was implicated, at least nominally, in the atrocities of the period. In 1793 he was sent to the department of Nièvre to enforce the law against such persons as had incurred suspicion. In 1794 he incurred the hatred of Robespierre, and thus had a strong stimulus to assist in his downfall. In August 1795, he was expelled from the convention, and kept a prisoner till the amnesty in October. In 1796 he communicated important information to the director Barras as to the designs of Babeuf and was rewarded in 1798 by being sent to Milan as ambassador to the Cisalpine republic. Here he labored with Gen. Brune to establish a second 18th Fructidor; both were in consequence recalled. He appeared in Paris in 1799, after Barras had gained the ascendency, and was appointed ambassador to Holland.

Shortly after Fouché was recalled and named minister of police. Here he first had full opportunity to display his great talents, and exercise an important influence on the interior policy of France. The situation gave him great power during the war. After the battle of Waterloo, Fouché urged Napoleon's second abdication, and advised him to seek an asylum in the United States. He placed himself at the head of the provisional government, negotiated the capitulation of Paris, obtained the removal of the army behind the Loire, and thus prevented useless bloodshed. Louis XVIII., whose return to the throne he had not at all supported, made him again minister of police; and it is to his credit that he labored so zealously in favor of moderate measures as to incur the hatred of all the ultra-royalists. He therefore resigned his office in 1815; and went as French ambassador to Dresden. As he was struck at by the decree issued in 1816 against the murderers of the king, he sought an asylum in Prague. He afterward went first to Lintz, and then to Trieste. It was Fouché who made the famous remark on the execution of the Duke of Enghien, of which he disapproved: "*C'est plus qu'un crime, c'est une faute*" (It is more than a crime; it is a blunder). Consult Martel, 'Etudes révolutionnaires: Etude sur Fouché' (1819).

Foucher, Jean, zhôṅ foo-shā, early explorer and colonizer in South America: b. Cambrai, Flanders, 1508; d. 1567. He was with Sebastian Cabot at the discovery of the Paraguay River, in 1534 shipped as pilot to Mendoza's expedition to Paraguay, led an exploring party to the foothills of the Peruvian Cordilleras, and was a counselor of Cabeza de Vaca (q.v.), with whom he was sent prisoner to Spain. Having received pardon he was appointed governor of Entre Rios, where he maintained a friendly attitude toward the natives and made further explorations.

Fouchet, Jean Antoine Joseph, zhôṅ äṅtwän zhō-zĕf foo-shā, Baron, French diplomatist: b. St. Quentin, France, 1763. The date of his death is not known. He was a law student in Paris when the Revolution broke out and published a pamphlet in defense of its principles. Soon afterward he was appointed a member of the executive council of the Revolutionary government, and was French minister to the United States in 1794–5. Subsequently under Bonaparte he was prefect of Var and, in 1805, of Ain. On Napoleon's return from Elba he was made prefect of the Gironde.

Foucquet, Jean, zhôṅ foo-kā, French painter: b. Tours about 1415; d. Paris about 1485. He received his early artistic training in Italy, where he painted a portrait of Pope Eugenius IV., and later entered the service of Louis XI. of France. For the king he executed several portraits. His best work consists of 40 miniatures in a prayer-book for Etienne Chevalier. Only in comparatively recent times has he been recognized as a founder of the French school.

Foula, foo'la, island, the most westerly of the Shetland group, lying 16 miles southwest of the nearest point of mainland. It is a little over 3 miles in length and is 2½ miles in breadth. Pop. (1900) 326.

Foulis, fowlz, **Robert** and **Andrew,** Scottish printers: b. Glasgow, the former in 1707; d. 18 Sept. 1781; the latter in 1712; d. 178[illegible]. In 1739 Robert commenced business in Glasgow as a bookseller; and in 1742, having obtained the appointment of printer to the university, began in that capacity to issue editions of the ancient classics, which have made his press famous, both from the beauty of their type and their accuracy. In this latter respect one of his editions of Horace stands pre-eminent, and is hence known by the name of the 'Immaculate' edition.

Foulk, George C., American naval officer: b. Pennsylvania about 1860; d. Kioto, Japan, 1894. He was graduated from the United States Naval Academy, and after service on the Asiatic station, was withdrawn from naval duty to act as secretary and interpreter to the embassy of the Korean empire, the first sent by that country to a western nation. In 1884 he became naval attaché to the American legation at Seoul. He traveled widely in the country, and was influential in introducing many western methods and manners. Later he again served in the navy, and became professor in Doshisha University at Kioto, Japan.

Foulke, William Dudley, American author: b. New York 20 Nov. 1848. He was graduated at Columbia in 1869, at the Law School of the University in 1871, practised law in New York, removed to Indiana, and there became a member of the State Senate (1882–6). In 1889–90 as chairman of a special committee of the National Civil Service Reform League, he made important investigations in connection with the United States civil service. In 1893 he was chairman of the Suffrage Congress at the World's Columbian Exposition. His publications are: 'Slav or Saxon' (1887); 'Life of O. P. Norton' (1899); 'Moya' (1900).

Foundation. The term designates either the lower courses of a masonry structure, or a specially prepared surface or bed in contact with the soil or bed-rock upon which a structure of any kind is to be built. In practice there are many cases, however, in which the bed and the lower courses of the masonry structure jointly comprise the foundation proper, and render difficult or unnecessary the drawing of any marked distinction between them. Such combinations generally afford foundations of great permanency and strength, the most important qualities in connection with architectural and engineering works.

Oftentimes, in the erection of such works of great magnitude as well as those of lesser importance, the requisite care and attention are not devoted to the construction of the foundations, thus seriously impairing the integrity of the superstructure. This carelessness, however, appears to develop periodically; but, the errors of one period are naturally so fruitful of injurious results that they not only lead to the exercise of greater care during the period following, but stimulate the development and adoption of more scientific and skilful methods.

This is very clearly shown in the works constructed during the Roman Period. The earlier Romans erected their buildings on the most solid foundations constructed of large blocks of concrete, composed of quarry rubbish, gravel, or burnt earth, bonded by an excellent mortar. This material formed under the superstructures

homogeneous basements of veritable artificial rocks capable of sustaining the heaviest of buildings without rupture or settlement. During the later Roman period, however, the foundations were much neglected, so that the architects of the 12th century were afforded so many examples of important edifices fallen on account of bad foundations, and for no other reason, that they were compelled to exercise greater care, and employ more skilful methods.

These remarks are especially applicable to the foundation methods practised at the present time. The architectural and engineering works of to-day have passed from the types of comparatively light superstructures to those of mammoth size and enormous weight, requiring the strongest and most permanent foundations that modern engineering skill is capable of designing, and the application of reinforced concrete or concrete steel methods to the construction of practically all classes of foundations appears to represent the best practice of modern times.

The employment of a particular type of foundation depends upon the character of the soil and the presence of water, and the widely varying conditions met with in practice have developed several classes of foundation structures which may be briefly designated as peat foundations, sand foundations, hard soil foundations, pile foundations, etc., which may be more intelligently described in the special paragraphs following a few very general but necessary remarks on foundation soils.

Foundation Soils.— These vary in character from hard and solid bed-rock, hard-pan, and firm sand to liquid mud, quicksand and silt. It is clear that hard bed-rock, hard-pan, firm sand, and various kinds of compact clays are the best materials to sustain foundation structures; but practical experience has very satisfactorily demonstrated that almost every substance in nature is capable of supporting the weight of any other substance, no matter how small the sustaining capacity of that material may be, provided the weight to be sustained is distributed over a sufficiently large area, and provided the conditions of the soil are permanent. Under any conditions, however, other than those obtaining in the case of solid rock, the adoption of the particular type of foundation requires the exercise of the highest order of forethought on the part of the constructing engineer in arranging for the proper distribution of the weight of the superstructure, and in providing means to counteract the injurious effects of any vibration to which it might possibly be subjected.

The sustaining power of soils depends upon their composition, the amount of water which they contain or which may drain through them, and the degree to which they are confined. Sound hard bed-rock of ledge formation will support loads up to 36 tons per square foot, but if the rock is seamy and rotten its sustaining capacity will be materially less, and will require special treatment in the construction of foundations thereon. In general, the composition of the different kinds of substrata varies so greatly that it is impossible to apply specific rules; but the latest practice assumes the following safe allowable pressures: For hard-pan, eight tons per square foot; compact sand and clean gravel free from lateral movement, five tons per square foot; dry clay, three tons per square foot; and loam, one ton per square foot Soft, watery clays, mud, quicksands, and silt have very little or no sustaining power, and have to be penetrated until firmer material is reached, and require to be compacted by draining, or consolidated by other means. If piles are employed, and they are driven to bed-rock or to refusal, the sustaining power is determined by the crushing strength of the material of the pile — timber, iron, or reinforced concrete, as the case may be.

Peat Soil Foundations.— In soils such as peat, it is almost impossible to carry the walls down to a sufficient depth to reach a solid base. In such cases one of three methods has to be adopted — to lay a strong concrete floor spread over a sufficient area; to use cylinders of iron or brick work; or to employ piles. If a concrete floor is employed, it should cover the entire surface to be occupied by the building, and should extend to some distance beyond the footings of the walls in order to prevent cracks and settlements. These injuries are usually caused by heavy walls being placed too close to the edge of the concrete floor, causing it to buckle and crack, and to settle irregularly under the unequal weights of walls of different thickness. This condition is somewhat obviated under the French system by forming a lip under the edge of the concrete floor, converting it into a kind of inverted tray which confines the substratum within its limits. The material of the foundation should be strong and homogeneous, while that of the superstructure should be of the coursed and bonded, or articulated, construction, so that if necessary it would yield slightly at the joints and thus accommodate itself without fracturing to any slight or unequal settlements during construction.

Sand Soil Foundations.— In hard stable sand or gravel, or in compact dry clay above water level, the construction of strong, permanent foundations require comparatively simple methods. If the location is in cold countries, the preliminary excavation is carried well below the frost line, and the bottom is carefully leveled off to receive the concrete bed, or the broad footing formed by the lower courses of the masonry.

In the case of compressible soils, artificial means in the form of piles, or of beds of concrete are first employed to reinforce the sustaining power of the substratum, and upon the platforms thus obtained the foundation proper is then constructed. On the other hand, if the foundations have to be constructed upon running sand, the greatest care and skill is required to prevent the work from being undermined by pumping out sand with the water during constructing operations. About the only way to handle such a case is to make a good concrete floor the entire width of the trench by putting it in as quickly as possible, sealing up the sides of the trench, and then pumping out the water when it reaches the level of the top of the concrete, and not from a sump. In building dock-wall upon running sand, the probable effects due to the cessation of pumping operations in the course of construction, require to be carefully considered. In such a case, the entering water will exert a varying pressure on the floor of the dock and the foundations of the walls according to the difference of tide levels on the outside of the dock.

Foundations for bridge piers on or across

sand are usually constructed by sinking iron tubes or piles equipped with large disks or screw shoes at their lower ends, the diameters of which are regulated to support the weight intended to be placed upon them.

Clay Soil Foundations.— As in the case of sand and gravel free from lateral movement, the construction of foundations i.. dry clay calls for the application of the simplest methods; but, in clay strata impermeated with water, and having a tendency to slide, especially in the case of hillside excavations, the problem becomes more difficult and complex, and requires special methods for its successful solution. As a rule, such soils do not slide piecemeal, but move as a mass with an almost irresistible energy capable of rupturing the strongest timbers as if they were toothpicks. The only way to proceed in such cases is to disturb as small a section as possible at a time so that any forward impulse may not be communicated to the entire mass, and to provide strong cross walls in the basement to act as buttresses. The foundations should be carried down to or below the ultimate drainage level so as to prevent shrinkage by any subsequent draining of the subsoil which will lead to disastrous settlements.

Pile Foundations.— These consist of groups of piles of timber, iron, or concrete, plain or reinforced, sunk into the substrata and capped with platforms of timber or concrete upon which the superstructure is finally built.

Timber piles are tree trunks of varying diameter and length, with the bark removed and the knots and lateral branch stems cut off. Iron piles are of two kinds: the screw pile, consisting of a shaft of iron or wood, equipped at the foot with an iron casting in the form of two screw blades ranging in size from one to five feet in diameter; and the disk piles, consisting of hollow tubes carrying disks at their lower ends instead of screw blades. Concrete piles consist of cylinders of concrete formed in place, and of columns of reinforced concrete of rectangular cross-section made above ground and subsequently driven into place by means of a pile driver.

Various methods are employed to sink or drive piles into place. Timber piles are driven by the use of hammers which are raised and dropped by some form of engine developed power, and by the aid of jets of water under pressure, as suggested by Sir James Brunlees as early as 1850, and first employed by him in connection with the sinking of iron piles in the construction of the foundations to carry a railway across the treacherous sands of Morecambe Bay. Some of the most notable deep pile foundations constructed by the driving method are those under the new Public Library building, and the Illinois Central Railway passenger station in Chicago, Illinois. The passenger station consists of a structure 180 by 220 feet in plan, 9 stories high, with a tower 13 stories high, and a station 3 stories high connected with a train shed 680 feet long. Borings taken on the site showed the substrata to consist of ten to twenty feet of rubbish accumulated by dumping, and below that, several irregular layers of stiff blue clay and quicksand down to bed-rock, more than 60 feet below the surface. These conditions led to the adoption of a deep pile foundation, and about 1,700 piles, arranged in groups or clusters, were driven under the columns. These piles ranged in size from 40 to 60 feet in length, and from 11 to 16 inches in diameter at the butt. Thirty-two per cent were black gum, 22 per cent pine, 21 per cent oak, 7 per cent basswood, and 15 per cent hickory, with a few maple and elm. They were driven with drop hammers weighing 2,800, 3,200, and 3,800 pounds respectively, the fall ranging from 35 to 50 feet. A cast iron cap was fitted over the heads of the piles to prevent them from being crushed or split, but in spite of this protection over 8 per cent of the heads suffered serious injuries of that character. The piles were all driven in groups until the tops of all were below the leads, then the driving was completed by the use of a follower. Water was kept running continuously around the pile at the surface during the driving operations and was found to materially aid in the sinking of the piles. After the piles had been driven home, the tops were sawed off to a uniform height of three feet below datum, thus placing all the timber below low water level. As this was at least ten feet below the surface, the trenches had to be sheathed, and were kept drained by continual pumping. The earth was excavated to the depth of 18 inches below the top of the piles and rich Portland cement concrete was tamped in flush with the tops. Finally, oak caps 12 inches square were drift-bolted to the centre of each pile, and the space between the timbers was filled with concrete.

When piles are sunk with the aid of jets of water, the work is accomplished much more simply and rapidly than by driving. A pipe two or three inches in diameter is attached to the side of the pile and connected to a pump. The pile is first covered with pitch and then the water is forced through the pipe under the bottom of the pile, so that the sand is converted to a degree of fluidity that allows the pile to descend rapidly to the desired depth. When one pile has been put down home, the feed pipe is detached and spiked onto another and the operation is repeated. The accuracy and certainty of this method is so great, that it is a common practice to make the holes for the bolts in the piles before they are brought into position. After the pile is down and a reasonable length of time has been allowed for the churned up sand to subside, it recovers its solidity and grips the pile so tightly, that it is almost impossible to start it again.

When hollow iron piles are used, the water is conveyed through the centre of the tube under hydraulic pressure, disturbing the sand under the piles and allowing them to sink by their own weight to the proper depth. Upon withdrawing the pressure and stopping the flow of water, the sand returns to its former consistency and holds the pile stationary. Numerous valuable and interesting experiments show that the gripping power of quicksand is equivalent to a uniform supporting power of five tons per square foot, and that such sands possess this power at the depth of only a few feet below the surface, and, furthermore, that an increase in depth is not accompanied by a relative increase in the supporting power. Under favorable conditions the water jet method can be applied equally well to the sinking of cylinders and caissons.

Concrete piles have been used during a comparatively recent period, but their success has

been so great that their development in the future promises to bring them into general use in the place of timber and iron piles. These piles, as previously mentioned, are either formed in place, or they are molded above ground. A great many methods have been suggested for forming the hole to contain the concrete when the pile is formed in place. One method consists in driving a double shell of metal into the ground and then withdrawing the inner shell, leaving the outer shell as a mold for the concrete. Another method, shown by Fig. 1, employs a single shell equipped with a concrete or a steel point. The shell is first driven to the desired depth and then withdrawn slowly and the space it occupied filled with concrete, the surface being kept at a sufficient depth below the end of the tube to maintain the head required to resist the pressure of the ground. Concrete piles used for underpinning are usually sunk with the aid of the water jet to a depth sufficient to reach firm strata, and the bottom of the excavation is enlarged by means of a spiral expanding device so as to form a base, as shown in Fig. 2.

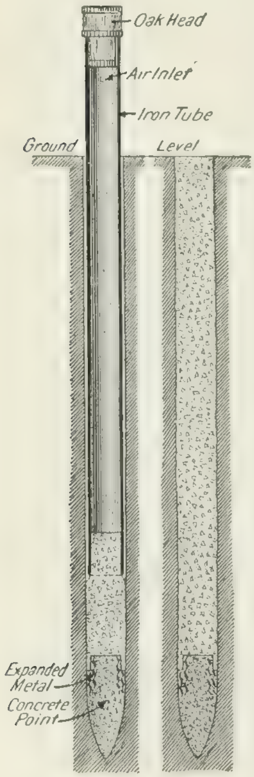


Fig. 1.

Piles made in place may be reinforced, if desired, but usually reinforced concrete piles are formed above ground. They are designed like columns, the reinforcement consisting of vertical bars of steel connected at intervals with horizontal wire rods or plates. Up to the present time they have been made only in square and triangular cross-section, circular molding being too expensive, and the arrangement of the required reinforcement being too complex. The general character of these piles is illustrated by Fig. 3, which shows the construction of the piles designed (but not used) for the foundations of the Hallenbeck building, New York city.

The supporting power of piles depends upon their action as a column resting on a hard base, or upon the friction against their sides developed by the gripping action of the material through which they have been driven. Very often the supporting power is a combination of both actions. The amount of this power may be calculated in various ways, but at their best the results are of necessity only approximations. The supporting power of a pile driven to bed-rock is determined by the crushing strength of the material of which it consists, but if it is supported wholly or in part by friction, its supporting power is calculated by a formula based upon factors obtained by experiment, or upon the distance penetrated by the pile under the blow of the driving hammer. A formula based upon the last named factor and commonly used for determining the safe loading on piles is given by the expression —

$$P = \frac{2Wh}{p + 1},$$

in which P = safe loading in tons upon a pile, W = weight of hammer in tons, h = height of fall in feet, and p = penetration in inches under last blow.

The construction of the pile foundations for the Chicago Public Library building afforded valuable information relative to the supporting power of piles as determined under actual conditions. Piles of Norway pine were driven with a steam hammer having a total weight of 8,300 pounds, the hammer alone weighing 4,500 pounds and delivering 54 blows per minute, with a stroke of 42 inches. The last 20 feet of driving was accomplished by means of a follower. The piles were placed about two and one-half feet centre to centre and the supporting power of four piles was tested by building a platform on top of them and loading it with pig-iron. Levels were carefully taken on each pile. They stood four days with a loading of six tons on each pile, eight days with a loading of 37 tons per pile, and 10 days with a load of 50 tons

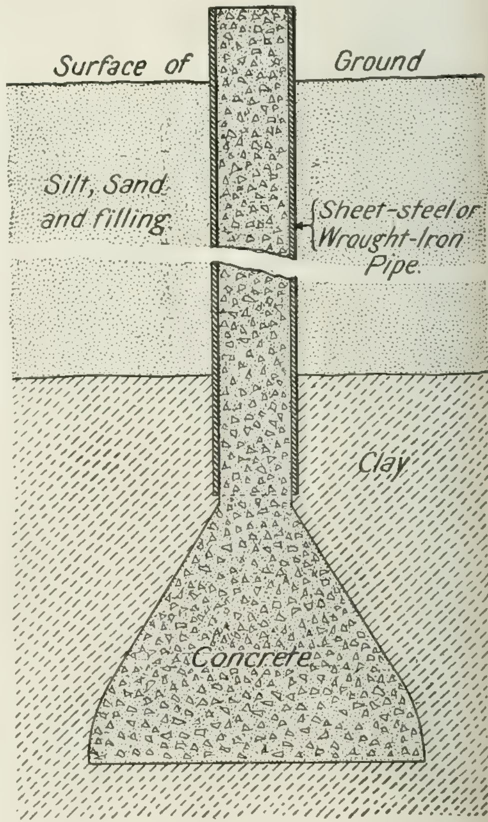


Fig. 2.

per pile. The settlement did not exceed 0.01 of a foot. These tests indicate that if 250 pounds per square inch be assumed for point resistance, the average frictional resistance will amount to about 3.2 pounds per square inch of side surface of pile, or about 432 pounds per square foot. In the case of an ordinary pile, seven inches through the top and 14 inches at the butt, driven to a depth of 45 feet, the point resistance would be 6,000 pounds, and the frictional resistance 59,000 pounds, a total earth resistance of 65,000 pounds, equivalent to the supporting power of the pile considered as a column, and allowing a factor of safety of 3 to 4.

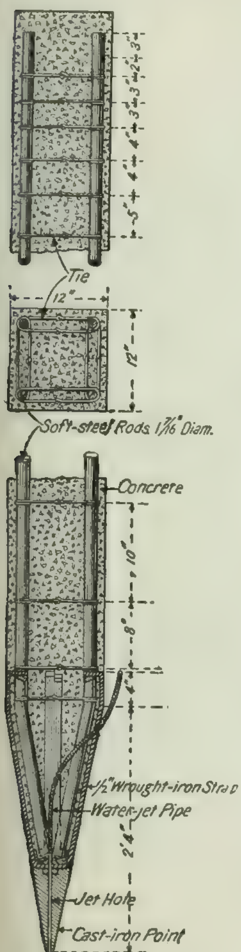


Fig. 3.

Usually, the determination of the point at which a pile is considered as having been driven to a firm bearing depends greatly upon the judgment of the engineer in charge, based upon his experience in the particular locality in which the work is being performed. The best practice, however, affords the following safe specifications of allowable penetration. For piles meeting a hard resistance a penetration of one inch under the blows of a 2,000-pound hammer falling 10 feet, and for piles held by friction, a penetration of three inches under the blows of a 2,000-pound hammer falling 15 feet. The minimum distance between centres usually depends upon the hardness of the substrata and the size of the butts. Spruce piles may be advantageously driven 24 inches between centres, while large and long piles ought not to be driven closer than 30 inches between centres. Another factor that must be carefully considered is the supporting power of the soil as a whole. For example, if that power is equal to two tons per square foot, and each pile is capable of sustaining 18 tons, it is useless to place the piles closer than three feet between centres.

In connection with the use of timber piles in places where the durability of the timber is very liable to be seriously impaired by the attacks of the Teredo worm, the latest practice appears to favor the system of armoring them with concrete. In such cases the timber piles are usually driven in sets of three to a firm bearing. They are then cut off, one two feet, one four feet, and one eight feet, below the level of the wharf platform. A wooden stave cylinder of three-inch planking is then placed around the piles and driven into the mud to a depth of 12 feet, and the bottom of the cylinder sealed. The contained water is then pumped out, and a cylinder of expanded metal is set within the wooden cylinder, and the remaining

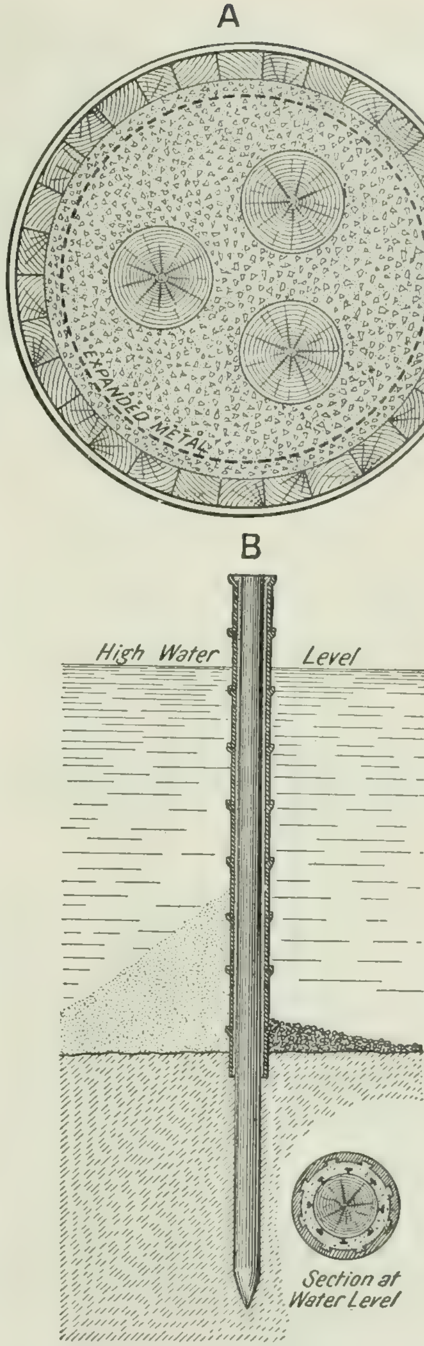


Fig. 4.

space filled with concrete. Diagram A, Fig. 4, illustrates this protective method as employed in wharf construction on the Pacific coast.

Another method still more recently introduced consists in the use of terra-cotta pipes as an outer covering for the piles. In this case the armoring is limited to individual piles. Before driving the pile, large-headed nails are driven into the surface of the wood near the level of the water line. The pile is then driven into place and the sections of terra-cotta pipe placed around it. The annular space of about two inches between the inner surface of the pipe and the pile is then filled with concrete. The method is especially applicable to works along the coasts of the South Atlantic and Gulf States, where there are no ice fields to contend with, and where no strong tidal and river currents necessitate the use of heavy masses of stone to protect the piles from the great force thereby exerted against them. This method is illustrated by diagram B, Fig. 4.

Platform Foundations.— These structures are designed to distribute a concentrated weight over a large area in soft substrata when piles are not employed. They may consist of beds

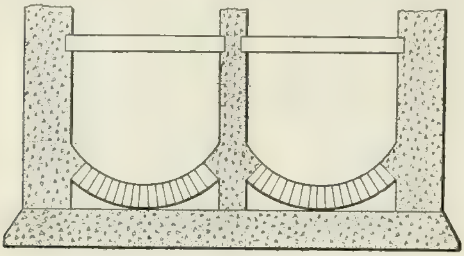


Fig. 5.

of concrete, or of masonry or brick arches sprung between supporting piers or columns, as shown by Fig. 5. They may also consist of platforms of timber grillage — timbers placed across each other in alternate layers, or of platforms of concrete or masonry reinforced with a grillage of steel bars, as illustrated by Fig. 6, which shows the platform foundations of a World's Fair building in Chicago, consisting of a concrete bed reinforced with a steel rail and I-beam grillage, to support the base castings of the main columns.

Subaqueous Foundations are those constructed in the substrata of river beds or other bodies of water, or where the existing conditions necessitate the building of structures in water and below the level of its surface. This class of work is accomplished by the use of cofferdams, cribs and open caissons, pneumatic caissons, by dredging through wells, by forcing cement into the substrata under pneumatic pressure, and by freezing the substrata.

Cofferdam Method.— The use of cofferdams is limited to the construction of foundations in shallow waters where the depth of the necessary excavation to reach a firm bearing is small, or in water bearing substrata on land. They are usually constructed by driving a double row of sheet piles — heavy timber planking — around the area in which the foundation is to be built. The space between the piles is then tamped in solidly with clay, and the water pumped out of the enclosure, so that the work of excavating and the subsequent masonry construction may be carried on in the open air. Cofferdams are sometimes constructed of walls composed of bags of clay piled around the foundation area, and reinforced with barrels of sand banked on the outer side of the walls.

Crib and Open Caisson Method.— Under this method, the foundation bed is first prepared by dredging until a solid material is reached, or by driving piles to a sufficient depth to reach a firm bearing. When piles are employed they are cut off at a uniform depth below the level of the water surface and constitute the supporting bed of the caisson. The caisson consists of a water-tight box-like structure open at the top. It is floated over the position of the bed, previously prepared by dredging, and the masonry work built up in its interior until it gradually sinks and rests upon the bed. The side walls are then removed, leaving the bottom of the structure — the crib — in the foundation between the masonry and the supporting bed. Fig. 7 illustrates the foundation for a pier constructed by this method, the crib being supported by piles.

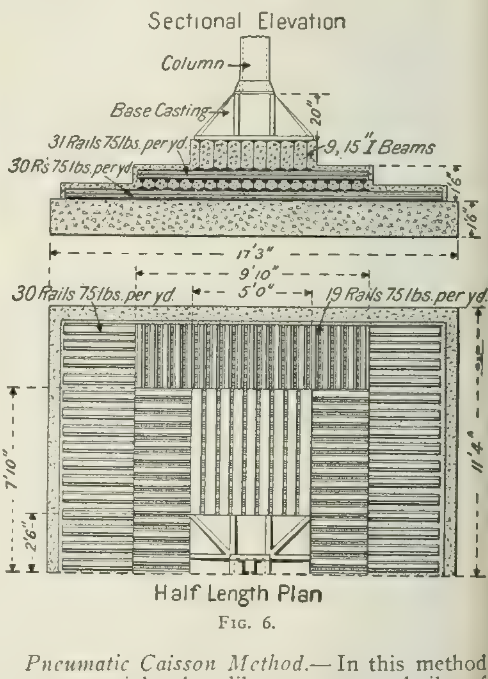


Fig. 6.

Pneumatic Caisson Method.— In this method two water-tight box-like structures built of timber or of metal are used. They are connected together one above the other, the lower caisson being inverted, that is placed bottom up, and the upper one open at the top. This structure is floated and anchored over the position selected for the pier and the masonry built inside the upper caisson until the lower edge of the lower caisson rests on the bed of the body of water. The contained water in the lower caisson is then expelled by compressed air, allowing men to enter and excavate the underlying material within the limits of the caisson. As the excavated material is discharged by being passed out through the top of the caisson, and the masonry work is added to course by course, thus keeping it always

above the surface of the water, the caisson sinks lower and lower into the substrata until it reaches solid rock or other firm material. The lower caisson is then filled with concrete, and the sides of the upper caisson are removed, leaving the masonry on the foundation formed by the lower caisson with its concrete filling. Fig. 8 shows the longitudinal section of a caisson of this type.

The pneumatic method, although one of the most effective, is limited in its application to work at a depth of about 100 feet below the surface of the water, as it is impossible for men to work conveniently and effectively under a

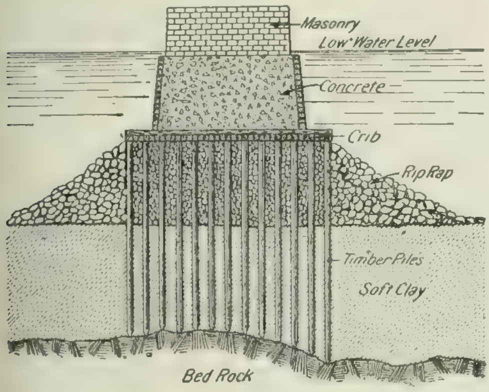


Fig. 7.

greater air pressure than that required to sustain a column of water of that height.

Although the iron-lined timber caissons used in the construction of the first East River or Brooklyn suspension bridge, measuring 102 feet by 168 feet each, with a working chamber 9 feet 6 inches in depth, are among the largest ever constructed, a clearer idea of the application of the pneumatic caisson method to works of great magnitude may be obtained from a description of the caissons used in constructing the foundations for the piers of the second East River or Williamsburg suspension bridge, completed in 1904.

This structure, although having a suspension

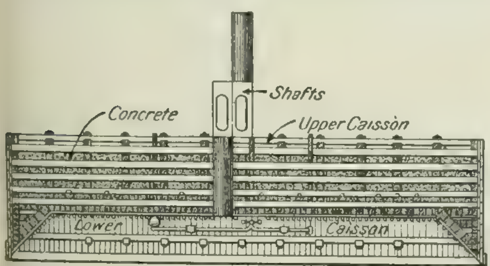


Fig. 8.

span the same length as that of the older bridge, is of much greater magnitude in many other ways. Each of its two steel towers is supported by two piers, as shown by Fig. 9. The following description is that of the north caisson of the New York tower, but it also applies in almost every particular to the other three. As determined by borings, the bed consisted principally of sand, and some clay and boulders. Below this, at a depth varying from 45 to 75 feet below high water level, the formation consisted of gneiss rock with a very irregular surface. The caisson was sunk through the sand, clay and boulders until it rested on the rock, which was then blasted away and stepped so as to make a fair bearing for the edge on all sides. The caisson measured 60 feet by 76 feet on the sides, with a total depth of 19 feet, and a working chamber 7½ feet in height. The walls were two feet nine inches thick and were built of two courses of 12 by 12-inch timbers, the outer course placed longitudinally and the inner vertically. Two layers of 3-inch planking were placed on the outside, and one layer on the inside. The bottom of

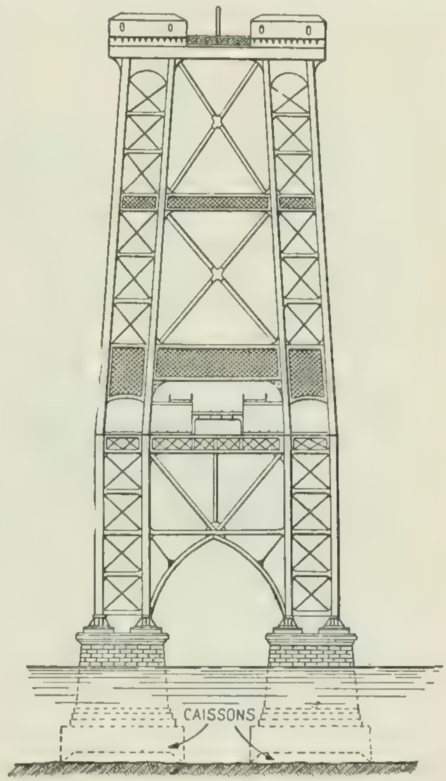


Fig. 9.

the walls was provided with a cutting edge, as shown by Fig. 10, which extended continuously around the whole caisson. This cutting edge was constructed of ½-inch steel plates, stiffened at intervals of 2½ feet of its length by knee braces. It extended two feet below the bottom of the lowermost timbers, and the lower 12 inches were stiffened with reinforcing plates, so that it had a total thickness of two inches. The cutting edge was not provided for the purpose of cutting through the bed of the river, but to enable the workmen to use their tools close to the outer edge of the walls of the caisson, which were nearly three feet in thickness, and also to facilitate the removal of obstacles, such as boulders, which could be dis-

lodged with less difficulty from underneath the two-inch edge than the bottom of the three-foot wall. The roof of the working chamber was five feet in thickness, and consisted of several layers of 12 by 12-inch timbers laid alternately crosswise and covered with alternate courses of 3-inch planks laid diagonally. The roof, and in fact the whole caisson, was stiffened with eight massive steel-plate riveted-trusses, which extended across from wall to wall. All the timbers of the caisson and of the roof were drift-bolted together so as to give great rigidity to the structure, and to make it perfectly water-tight. Additional strength was given to the working chamber by two solid bulkheads, which extended entirely across and divided it into three compartments, openings being provided for the passage of workmen. A massive framework or gridiron formed of 16 by 16-inch timbers was bolted together and to the side walls at the level of the lowermost timbers with 1½-inch steel tie-rods. From each

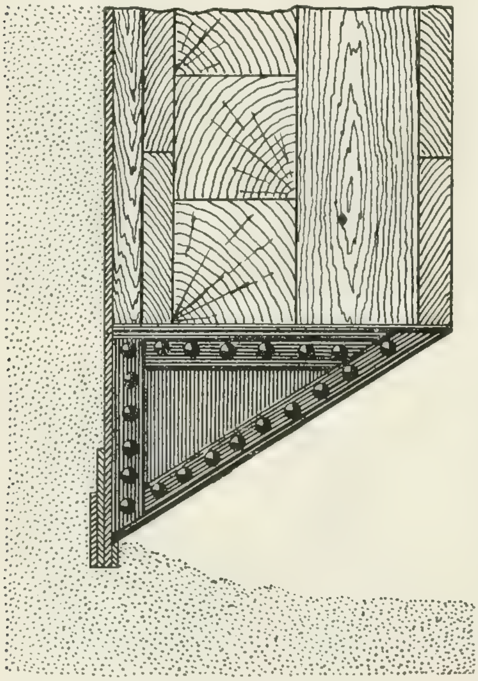


FIG. 10.

intersection of this framework vertical posts reached to the roof and were tied together and stiffened to resist lateral distortion, by diagonal struts and tie-rods, as shown in Fig. 11, practically forming two steel trusses nine feet three inches in depth, with a weight of 10 tons each. They were a novel feature in this class of work, but were rendered necessary on account of the shallowness of the caisson. The roof was pierced with seven shafts, each about three feet in diameter, for the passage of men and material, and several pipes ranging from one to five inches in diameter, for supplying air and water, blowing-out sand, and for carrying electric light wires. These shafts were of circular section, and were put in place in lengths of eight feet as the masonry work was carried upwards.

The piers on the Brooklyn side were constructed in a similar manner, with the exception that they were carried to a depth of 107 feet below high water. The last caisson to be sunk passed through 50 feet of water, 20 feet of sand, gravel and boulders, 30 feet of hard clay and hard-pan, and 12 feet of rock. The excavating of the rock was rendered necessary by the steepness of its slope.

The lower caisson measured 63 feet by 79 feet, and contained 74,700 cubic feet of timber, and 98 tons of iron, the greater portion of which was in the form of drift-bolts. Without the concrete filling it weighed 1,965 tons, and contained 6,000 yards of concrete above the roof of the working chamber. The upper caisson was 50 feet deep and contained 29,000 cubic feet of timber, and 32 tons of iron.

The sinking and concreting was accomplished in three months and six days, a very rapid piece of work considering the great depth to which the caisson was sunk. Down to the depth of 55 feet the men worked in eight-hour shifts. Below this depth the shifts were successively shortened as greater depths were attained. From 55 to 70 feet the shifts were six hours long; from 70 to 80 feet, four hours; from 80 to 90 feet, two hours; from 90 to 100 feet, one and one-half hours, and from 100 to 107 feet, 45 minutes. The pay of the men was increased in proportion to the depth at which they worked, and ranged from $2.50 for the eight-hour shift to $3.75 for the short shifts at the lowest levels. Although the air pressure at the depth of 107 feet was 46 pounds per square inch, there was very little sickness among the workmen, and only one serious case. The piers above the caisson foundation were built of limestone masonry up to low-water level, and, above that, of limestone with a granite facing.

Other notable examples of the pneumatic caisson method, both in the United States and in foreign countries, are the foundations of the centre pier of the Harlem River bridge, New York city; the Benares bridge over the Ganges River, India; the Poughkeepsie bridge over the Hudson River, New York; the Hawkesbury bridge, New South Wales, Australia; and the Jubilee bridge over the Hooghly River in Bengal. The centre pier of the Harlem River bridge supports the thrust of a 510-foot steel arch on each side of it, and stands on a timber caisson 54 feet by 104 feet, with a depth of 13 feet. It is divided into three compartments by vertical partitions, which not only served to strengthen the caisson, but protected the men during the blasting operations necessitated by the greatly inclined surface of the rock.

Foundations for piers or abutments of bridges, or for the main columns of high buildings, where the individual piece of work is of lesser magnitude than those already cited, are usually constructed by the use of cylinders of iron, as illustrated by Fig. 12. The arrangement consists of a cylinder of metal divided into two unequal parts by a horizontal partition — the upper and larger part, essentially a coffer-dam, being the caisson proper, and the lower part within which the excavating operations are carried on being the working chamber. It is provided with one or two shafts made of boiler-

plate, which are connected with the air chamber on top adjoining the equilibrium chamber or air-lock through which the workmen and materials must enter. A pipe from the air compressor furnishes the air chamber with compressed air, which is subsequently introduced by a system of locks to the working chamber below.

Dredging in Wells.— Beyond the limit of the effective application of pneumatic methods, about 100 feet below the water surface, all excavating must be accomplished by dredging, and special care has to be exercised in planning the method of operations to prevent any contingency arising at the bottom that would require to be dealt with by the use of human labor, as diving operations are impossible. It is also important to observe that the skin friction, quite unimportant in a cylinder of moderate depth, becomes so great at lower levels that special means have to be employed to overcome it. In the Benares bridge mentioned in the foregoing paragraphs, the principal piers are sunk to the depth of 140 feet below the level of the water, and consist of oval brick wells each 28 feet by 65 feet in diameter, the bottom lengths being cased in iron, as it was necessary to begin operations in the water. Each well is divided into three vertical compartments in which the dredging was carried on. In constructing the Poughkeepsie and the Hawkesbury bridges, almost identical methods were employed. In the case of the former, the caisson is of timber; it measures 60 feet by 160 feet, with a depth of 125 feet. It is divided into 40 vertical cells, and was sunk to a depth of 130 feet by filling in some of the cells and excavating in others. In the case of the latter, the caisson is of steel and iron, of oval form, 20 feet by 48 feet diameters, and splayed out at the bottom an additional two feet all around. It is divided into three dredging wells set on the centre line and parallel to its length. They splay out at the bottom so as to meet each other and the outer skin, thus forming a cutting edge. It was sunk to a depth of 161 feet below the water level by dredging in the wells, and by filling the space between the wells and the outer skin with concrete. This is probably the greatest depth ever reached in the construction of a bridge foundation.

The foundations of the piers of the Hooghly bridge were constructed by the use of similar caissons. The outer skin of the caisson, however, is entirely vertical, and the three dredging wells extend right across the structure, occupying the semicircular ends and the central portion. The weight for sinking was obtained by filling the two 15-foot intermediate spaces with concrete, and by placing a brick lining around the semicircular ends. It will be understood that in all these cases the dredging wells were finally filled up with concrete when the proper depth was reached.

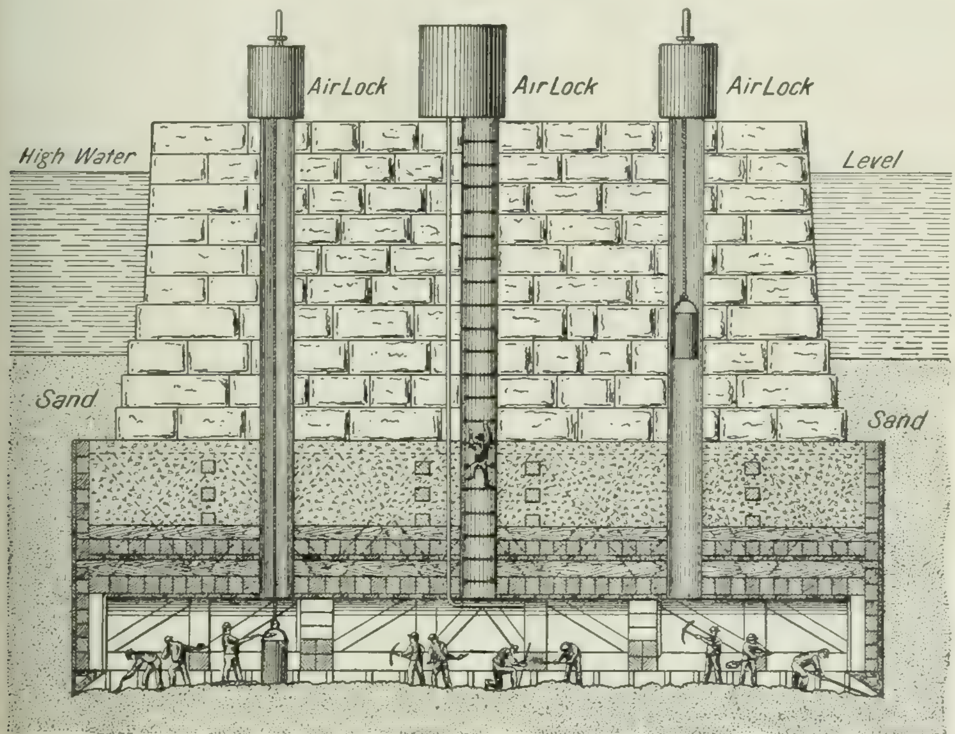


Fig. 11.

Pneumatic Forcing Method.— This is an improved method of constructing subaqueous foundations in sand or gravel substrata by converting it into a solid in the form of sand or gravel concrete. This is effected in place, without excavating operations, by forcing cement

in the form of the dry powder in which it is furnished commercially, through a pipe by air pressure into the substrata. The charging pipe, called the lance pipe, has an internal diameter of 1½ inches, and is drawn to a point at the lower end, and perforated with three or more holes ⅜ of an inch in diameter. The upper end of the pipe is connected by means of a bend and rubber tubing with the air pressure supply pipe, suitable arrangements being provided to raise, lower, or move it while in operation. The air pressure supply pipe is provided with suitable branches fitted with stop-cocks to permit of its being connected to an injector device by which any desired quantity of cement powder may be fed into the current of air. In operation, the air pressure forces the cement powder through the small openings at the lower end of the lance pipe and drives it into the substrata of wet sand or gravel, with which it combines and forms sand or gravel concrete as the case may be. The lance tube may be sunk to depths of 16 or 19 feet in a comparatively short time, and in order to insure a uniform mixture in the foundation pit, the foundation area is divided into small fields 8 to 12 inches square, into each of which the proper quantity of cement is blown. The proper amount of the cement charge is determined by dividing the cubic contents of the field by the required proportion of the mixture. Usually, the saturation of the sand is so thoroughly accomplished that when the forcing operations are discontinued, the particles of sand, if allowed to come together, would adhere to each other with a great deal of energy, so much so that it is well known to all makers of concrete, whether by hand, mixer, or mill methods, that the volume of the resulting material is always less than the sum of the volumes of the ingredients in their free and uncombined state. Experience has demonstrated that the best proportions of the two ingredients are one part by volume of cement to five parts of sand, or sand and gravel, measured in the same manner. This method was first suggested by Fr. Neukirch, of Bremen, Germany, and is being extensively used in various ways other than the construction of foundations proper, for such purposes as the consolidation of the soil around brick sewers, in the building of quay-walls, and in many other cases where the driving of cofferdams would be dangerous or impracticable.

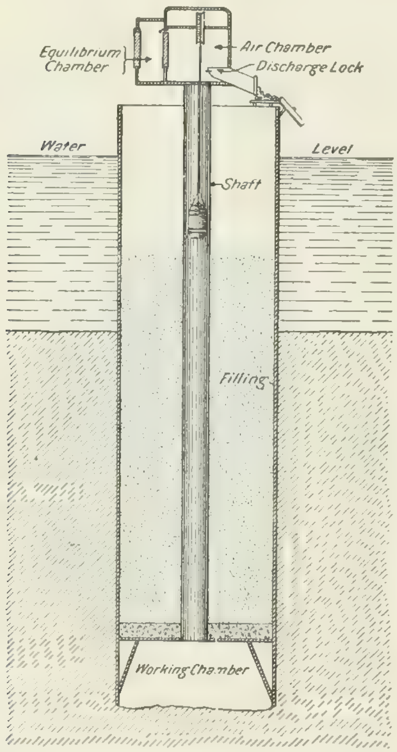


Fig. 12.

Another method by which bodies of cement or concrete may be placed in quicksand substrata employs pipes in the following manner: Two or more iron pipes are sunk through the quicksands to the desired depth, and water pumped into one of the pipes, thus converting the substrata into a condition of fluidity sufficient for the purpose of pumping it out through the other pipe. The cement is then introduced through the forcing pipe and filled into the agitated area at the bottom of the pipes.

Freezing Method.— This method is employed in the construction of subaqueous foundations, or of foundations in quicksand, or in soft water-bearing substrata, where the fluidity or lack of plasticity of the soil requires it to be artificially consolidated before excavating work can be instituted therein. In the Poetsch process, a large number of pipes are distributed as uniformly as the unstable conditions will permit, and are then filled with a strong freezing liquid which is maintained in a state of constant and active circulation until the substrata becomes solidly frozen. The excavation is then made in the frozen material, and the foundation put in and allowed to set firmly, after which the freezing operations are discontinued and the substrata allowed to thaw and assume its normal condition around the work. The method is not one that bears recommendation for works of magnitude. The thawing sands usually return to a state of unstable equilibrium not very conducive to the permanency and stability of the structures built therein, and besides that, the cost of the refrigerating plant, together with the accessory machinery and appliances, is so excessive as to be practically prohibitory in ordinary cases. It may be advantageously applied, however, in many special cases, especially in the construction of subaqueous tunnels and for making repairs to all classes of subaqueous structures.

Bibliography.— For further information consult: Baker, 'A Treatise on Masonry Construction' (New York, 1900); Buell and Hall, 'Reinforced Concrete' (New York, 1904); Fowler, 'The Cofferdam Process for Piers' (New York, 1898); Patton, 'A Practical Treatise on Foundations' (New York, 1893); Taylor and Thompson, 'Concrete, Plain and Reinforced' (New York, 1905); and special articles on the subject in the various engineering magazines and periodicals.

William Morey, Jr., C.E.,
Consulting Civil and Mechanical Engineer, N. Y.

Founder, also called **Laminitis,** consists of inflammation of the vascular sensitive laminæ of the horse's foot Occasionally the laminæ are strained from severe exertion; more frequently they suffer from the morbid effects of cold, which is especially injurious after excitement and over-fatigue. The shoes must at once be removed, and the toes, if long, reduced, but no further rasping or cutting is permissible. The feet must be enveloped in hot bran poultices, and kept off the hard ground by a plentiful supply of short litter. Purgatives, if required, must be used with extreme caution. See HORSE, DISEASES AND CARE OF.— *Care of the Feet.*

Founders and Patriots of America, The, a society founded in 1896, and incorporated 18 March, of the same year, the object stated in the articles of incorporation being «to bring together and associate congenial men whose ancestors struggled together for life and liberty, home and happiness, in the land when it was a new and unknown country, and whose line of descent from them comes through patriots who sustained the colonies in the struggle for independence in the Revolutionary War; to teach reverent regard for the names and history, character and perseverence, deeds and heroism, of the founders of this country and their patriot descendants; to teach that the purpose of the founders could have had no lasting result but for their patriot sons; to inculcate patriotism; to discover, collect, and preserve records, documents, manuscripts, monuments, and history relating to the first colonists and their ancestors and their descendants, and to commemorate and celebrate events in the history of the colonies and the republic.» The order admits to membership any male citizen of the United States above the age of 21 years who is lineally descended, in the male line of either parent, from an ancestor who settled in any of the colonies prior to 13 May 1657, and whose intermediate ancestors in the same line during the Revolutionary period adhered as patriots to the cause of the colonies.

Founding. The art of making molds in sand, loam, or plaster of Paris, with or without the aid of patterns. The molds thus made are filled with molten metal which is subsequently allowed to cool and solidify into a metal casting corresponding to the form of the mold.

The various founding processes are characterized by the kinds of metal employed in the castings, such as iron, steel, brass, bronze, etc., and by the class of work produced, such as water pipes, car-wheels, ordnance, statues, bells, etc., involving the applications of special methods in the work of molding; in the melting of the metal; in the filling of the mold with the molten metal; and in the manner in which the metal is allowed to cool.

Molding in Sand.— The process of molding in sand by means of patterns embedded in flasks containing sand, is substantially as follows: The flasks, which are box-like arrangements provided with suitable handles by which they may be lifted and moved around, are generally used in pairs — the upper flask being commonly designated the «cope,» and the lower one, the «drag» or «swivel.» The patterns, usually of wood, are made either in one piece when the design of the casting is simple, or in several pieces when the form of the casting is more complicated. In molding, the drag is filled with sand and the pattern embedded in it. The cope is then placed over the drag and the sand rammed in tightly around the pattern. The pair of flasks is then turned over and the loose sand taken out of the drag and replaced by sand firmly rammed in its place. The flasks are now returned to their original position; the cope is taken off and the pattern removed. The cope is then replaced upon the drag, and the mold is thus made ready to receive its filling of molten metal. This is accomplished by pouring the metal through suitably formed gates or holes which extend through the cope and connect with the molded spaces in the drag.

The use of a separate appliance for a drag is very often dispensed with, the pattern being embedded in a bed of sand upon the foundry floor. This method is especially applicable when a large number of small castings are made at each pouring. Also, very often the patterns are made in two parts, that is, divided in the middle horizontally, so that one half of the mold is made in the drag and the other half in the cope. In the case of hollow cylindrical castings such as water pipes and the tubes of heavy ordnance, a cylindrical core of the proper dimensions is suspended in the drag mold before the cope is placed in position, and the annular space between the core and the interior walls of the mold is filled in with the molten metal.

Molds are made either in green or in dry sand. Those in green sand are suitable for the making of small and simple castings: but molds in dry sand are employed in the production of castings of large size and great intricacy of design. In such cases, after the molds have been finished, they are placed in drying ovens until they are thoroughly dried.

Molding in Loam.— In this process, the molds instead of being made by the embedding of patterns in sand, are formed by means of cores of metal or of brickwork which are covered by several coatings of loam — mixed sand and clay, to correspond with the form and dimensions of the desired castings. An outer shell constructed around the core thus thickened, provides the annular space for the reception of the metal. The method is especially applicable to the founding of hollow cylinders, bells, and statues. See titles FOUNDRY AND FORGE SHOP TERMS, and ORDNANCE, in this Encyclopedia.

Foundling, a child abandoned by its parents, and found by strangers. Though infanticide was not punished among the ancient nations, with the exception of Egypt, where the child's corpse was fastened to the guilty parent's neck for three days and nights, yet natural feeling would prompt parents to expose their offspring, and leave their fate to accident rather than kill them. They usually selected places which were much frequented, where there was a greater chance of the child being saved. In Athens and Rome they were exposed in especially appointed places. In the 4th century under the Emperors Valentinian, Valerius, and Gratian, the practice was prohibited. The Bishop of Treves in the 6th century allowed foundlings to be placed in a marble basin in front of the cathedral, thus entrusting them to the care of the Church.

In 787 a foundling hospital was established at Milan; one was established at Paris in 1362, but among the most famous of modern institutions is the foundling hospital in Paris formally established in 1670. It receives not only foundlings strictly so called, that is, deserted children of unknown parentage, but also deserted children of known parents, and destitute children generally, as well as children pronounced incorrigible by the courts or declared to be so by their parents.

England has no foundling hospital properly so called; all exposed children are brought up at the expense of the parish in which they are found. The Foundling Hospital in London, established by Thomas Coram, a master-mariner, in 1739, was originally a hospital for exposed and deserted children. It was for a time extremely popular, and was repeatedly assisted by parliamentary grants; but the enormous increase of abandonments, and the expense which they occasioned, produced such an alteration in public opinion that the hospital was changed to what it now is, a hospital for poor illegitimate children whose mothers are known.

In the United States foundlings are usually consigned to the county poor farm, but Foundling and Maternity Hospitals exist in the principal cities. Foundling hospitals are said to diminish not only the exposing of children, but also to render infanticide and intentional abortion less frequent. The objection that they contribute to the corruption of morals, if they receive children indiscriminately, and that they encourage parents to rid themselves of responsibility, is the strongest which can be urged against such institutions, and is not easily answered. In Massachusetts foundling hospitals are legally forbidden. In New York city foundlings are sent to Bellevue Hospital, and formerly were transferred to the Infants' Hospital on Randall's Island or in the borough of Brooklyn, to Flatbush. The rate of mortality among them was alarming; in 1897 all children received at the Randall Island institution died before reaching the age of two years, chiefly owing to the change of food and neglect before and exposure during abandonment. At baby farms, private institutions where babies were boarded for gain, the same conditions also prevailed. The attempt to remedy these deplorable conditions has met with great success since 1899. The work is supervised by the Joint Committee on the Care of Motherless Infants under the control of the State Charities Aid Association and the New York Association for Improving the Condition of the Poor, and their fifth annual report for the year 1903 shows the rate of mortality has decreased to 11 per cent as compared with 55.9 per cent in 1899, the first year of their work. Foundlings of whose parentage nothing is known are baptized alternately Roman Catholic and Protestant, the Roman Catholic children being in charge of the Guild of the Infant Saviour, while the committee care for the Protestants. In connection with this admirable work is an agency for providing situations in the country for destitute mothers with infants. The *mothering* system has been long enforced in the Chicago Foundling Asylum, and is being adopted in similar institutions throughout the States. Consult: Folks, 'Care of Neglected and Dependent Children' (1901); 'Reports of the Joint Committee on the Care of Motherless Infants'; 'New York Association for Improving the Condition of the Poor' (1903).

Foundry and Forge Shop Terms. The following list of terms includes some of the most significant words and phrases commonly used in connection with foundry and forge shop operations.

Angles.— Strengthening pieces which run around the angular portions of castings.

Annealing.— The subjection of brittle and non-elastic metals to the action of long continued heat, which effects a rearrangement of the ultimate molecules, and makes the metal tougher or more homogeneous. Steel castings, old chains and rods, and other forms of hammered work, which have been used for a long time, are improved by annealing; but, newly rolled plates and bars, the fibrous condition of which has not deteriorated, are weakened in tensile strength by the process. Annealing is carried on by means of "annealing-ovens" into which the "annealing-pots" containing the articles which require to be annealed are run, and exposed to the action of the heat for periods ranging from several hours to several days as the circumstances may require. The function of the annealing-pots is the preservation of the contained articles from the action of the atmosphere during the process of annealing.

Bars.— The stays or bridges placed in molding boxes to support the sand which encloses the pattern. They are purposely cast as rough as possible in order to insure the adherence of the sand. Vertical or "cope-bars" have their edges kept about three-quarters of an inch away from the pattern and about the same distance from the joint of the box. "Flat-bars" or "drag-bars" are placed in the "drag" or bottom-half of the mold, and therefore, do not follow the outline of the pattern.

Battering-off.— The finishing of the surfaces of forged work by hammering while the metal is dropping to a low red or black heat.

Bead Slickers or Bead Tools.— Sleeking tools used by molders for smoothing the impressions of beaded work such as the ornamental fillet or strip curved around the edge of a casting.

Bedding-in.— The method of molding in which the pattern is embedded in a bed of sand on the foundry floor instead of being placed in a box mold and "rammed-up" with sand.

Binders.— Rosin, glue, wheat and rye flour, linseed oil, etc., employed for the purpose of giving strength to "core-mixtures."

Blackening.— Pulverized charcoal, coal, coke, and plumbago or graphite used by molders for sleeking over the surface of a mold in order to prevent the castings from becoming "sand-burnt."

Black Wash.— A solution used on loam-molds and dry-sand molds for the same purpose that blackening is used in green-sand molds.

Blast.— The volume of air artificially forced into furnaces and forges by means of bellows, blowers, and rotary fans, to accelerate the combustion.

Blowers.— Machines employed for the production of blast, ventilation, etc. The principal forms consist of blowing cylinders and pistons, and the rotary blowers or centrifugal fans which are operated by power driven belting. Ordinarily they deliver a blast ranging from four to six ounces, approximating to a pressure ranging from seven to ten inches as indicated by the water gauge.

Blowholes.— Hollow cavities in castings caused by the presence of bubbles of air, or gas in the mold due to imperfect venting. When of a bluish color, they indicate the presence of sulphur in the metal.

Bottom Board.— The board on which the joint of a pattern is placed when it is being rammed-up, either to sustain a weak pattern, or to make the molders' "sand-joint."

Bottom Part.— The "drag" or bottom-half of a mold. In "bedding-in" work, the portion of the mold in the foundry floor.

Burning-off.— A process of tempering springs. The spring to be tempered is first hardened by immersion in linseed oil. When cold, it is taken out and the adhering film of oil ignited and allowed to burn off, thus producing a temperature of at least 600° Fahr., which draws the temper of the spring and coats it with a black surface that makes it practically rust proof.

Burning-on.— The replacing of a broken-off or incomplete portion of a casting. A mold of the portion which is to be burned-on is placed in the proper position against the main casting, and the molten metal poured in. The metal is allowed to flow over the broken face of the casting and out through a gate at the side of the mold, until the broken face is in a state of local fusion. The gate is then stopped, and

the metal allowed to cool. Perfect amalgamation is attained by the method.

CASE HARDENING.—The treatment by which wrought-iron is hardened on the surface. It is first heated to a red heat in the presence of carbon, and absorbs enough of the carbon to transform it into steel on the outside. It is then chilled suddenly to harden the steel.

CHAPLET.— The metallic devices used for supporting the "core" of a mold. Chaplets are of various forms — the single-headed chaplets, the double-headed chaplets, the spring chaplets, and the adjustable chaplets. They are placed under the cores to support them, or above the cores to hold them down, or at the sides of the cores to enable them to resist the lateral pressure exerted by the flowing metal.

CHARGING.— The supplying of furnaces with fuel and ores. In a reverberatory furnace, the "charging-door" or the opening through which the charge is introduced, is located at the side; while in a blast furnace or cupola, it is located near the top at the level of the charging platform.

CHART METHOD.— A method for computing the weight required for holding down the cope and core against the raising effort of the head of flowing metal. It consists in the drawing to scale the outline of the form and size of the lifting surface, and the height of the fluid head, and computing from the figure thus obtained, the cubical contents, which multiplied by the decimal .26 gives the data for the necessary weight.

CHILLS.— Metallic molds into which specially mixed molten iron is poured for the production of chilled or surface hardened castings. They are made of a quality of iron of sufficient strength and ductility to allow for the alternate expansion and contraction to which they are subjected, otherwise they would not last longer than one heat. Chills used for casting chilled-rolls are made in sections. "Contracting-chills" are used for casting chilled car wheels, and are so constructed, that as the metal of the wheel cools and contracts, the chills close in and keep in constant contact with it.

CINDER-BED or COKE BED.— The first layer of coke placed in a cupola previous to the introduction of the iron. Its weight bears a definite relation to that of the iron, but varies with the condition of the furnace. The term "cinder-bed" is also applied to the beds of cinders sometimes placd under the molds and with which the vents are connected.

CLAMPING.— The weighting down of the cope of a closed mold preparatory to "pouring," to prevent its raising by the lifting force of the metal. It is accomplished by means of various forms of clamps and weights, the latter consist of piles of pig-iron piled in separate pigs on the cope, or cast-iron bars ranging from 1,000 to 2,000 pounds in weight, which are hoisted into position by a crane.

CLEANING or CLEANING-UP.— The smoothing of the surfaces of a foundry mold with trowel and cleaners, and blackening, preparatory to "closing" and "casting." Also, the removal of sand from castings by means of wire brushes and files, by means of tumbling-barrels, and by various pickling processes.

CLOSING-UP.— The placing on of the top-box or cope of a mold in readiness to pouring in the molten metal.

COLD SHUTS.— When cast metal pours thick, or when it is poured into the mold too slowly, it is liable to thicken and partly solidify in those portions of the mold where the casting is thin, thus preventing the metal which follows from properly amalgamating with it. The imperfectly united contact surfaces thus formed are called "cold-shuts," "cold-shorts," or "cold-shots."

COPE.— The top-box or upper-half of a green-sand mold.

CORE.— A body of green or dried sand placed in a mold to exclude the central or inner portion of a casting. They are made either in boxes called "core-boxes," or struck to shape upon a revolving bar, a mixture of loam being used for the body, and the required outline imparted to it by revolving it against the bevelled edge of a templet board called the "loam-board."

DRAWING OF PATTERNS.— The lifting of patterns from the sand. Also called "rapping," "delivery," etc.

DRAWING PLATES.— See Rapping.

DRAWING OF TEMPER.— The heating of steel to redness and then allowing it to cool slowly in the air. The reverse of "hardening" and "tempering."

DROP FORGING.— The method of forging iron by driving or pressing it into a die placed under a drop hammer. It is employed when a number of forgings of the same pattern are required. A great deal of this class of work is now accomplished by the use of steam-hammers and forging-presses.

FAGOTING.— The piling up of lengths of puddled bar-iron in fagots or bundles for the purpose of reheating and rolling.

FEEDING.— When molten metal cools, the outside portions will set first, while the inside portions will remain fluid for some length of time. As the inner portion cools, it will contract and shrink upon itself and leave a depression on the top face of the casting. To avoid this condition the heavier portions of the casting are fed with metal through a small rod called the "feeding-rod," inserted through the runner or the riser, which by its motion keeps a passage open for the inflow of the fresh metal introduced to compensate for the contraction. The metal used for this purpose is called the "feeding-head."

FLASK.— The box which holds the sand in which the pattern is rammed-up in the making of a mold. Flasks are made either of wood or of metal, and are parted horizontally into two or more sections. In a mold composed of two parts, the lowermost or the one which is molded first is called the "nowel" or "drag," and the uppermost or the one which is on top when the casting is poured, is called the "cope." When a flask consists of more than two parts, the sections between the cope and the drag are called "cheeks" or "intermediates." Flasks are provided with two loose covers called top and bottom boards, and they are designated as "two-part flasks," "three-part flasks," "four-part flasks," etc., according to the number of the component parts.

FLOOR RAMMER.— A flat-ended iron tool employed for ramming over large surfaces of sand.

FLUXES.— Substances used in a smelting, or in a melting furnace for combining with the earthy and other infusible matter present in ores, and which require to be separated from the metal, and which cannot be rendered fluid by itself at the temperature of the furnaces. The flux most widely used is a carbonate of lime in the form of limestone, clam and oyster shells, chalk, dolomite and calcite. Magnesia, fluorspar, feldspar, and calcspar are also suitable for this purpose. This by-product of the furnaces is called "slag."

FORGE.— The structure upon which a smith's fire is maintained. Forges are constructed of brick, of brick and iron combined, or entirely of iron. A forge consists of a hearth, tuyere, chimney, bonnet, and troughs for water and coal. The blast is produced either by bellows, or by rotary blowers and fans.

GAGGERS.— Short, conical projections cast upon the core-plates and the plates of loam-molds for the purpose of assisting the adhesion of the loam. The term is also applied to the hooks of cast-iron or of wrought-iron which are hung from the cross-bars of a molding box into the mold to prevent the sand from sliding out when the cope is lifted. They are necessary when the body of sand is more than sixteen inches square in area.

GATE.— The opening in the sand of a mold, which connects the "sprue" with the interior of the mold. The sprue is the orifice through which the molten metal is poured into the mold. Both terms are also applied to the bodies of metal which occupy the respective passages after the casting has been poured.

HARDENING.— The hardening of a metal is the result of an increase in its density. Few metals are capable of being hardened. The hardening of steel is effected by heating it to a cherry-red temperature and then chilling or cooling it suddenly by plunging it in water, oil, or other suitable solution, or by exposing it to a cold blast. The degree of hardness that may be attained depends upon the suddenness of the chilling. In hardening and tempering tools such as machine knives, taps, long twist-drills, reamers, milling cutters, etc., the danger of warping them by uneven heating, or by cold draughts, is avoided by heating them in special hardening and tempering furnaces. See Case Hardening and Tempering.

LIFTING.— The drawing out of a pattern from a mold. Also applied to the raising up or springing up of the cope or top-part of the mold caused by the pressure due to the head of the molten metal. This tendency is counteracted by the use of screw-bolts, clamps, and dead-weights. See Clamping.

LOAM WORK.— The making of molds in loam, as distinguished from that of molding in sand. The loam used in foundries consists of a mixture of clay, sand, and horsedung, ground up with water by means of a form of mortar mill called the "loam-mill." When cold, the loam has sufficient consistency to be struck up to any desired outline by means of a "loam-board." See Cores.

LYCOPODE.— A material used for "parting."

MATCH-PLATES.— A match-plate is a wooden board or plate of metal on the opposite faces of which two different portions of a pattern are attached. When the boxes containing the impressions are brought together, they constitute a complete mold. In some cases they are very useful for facilitating the making of joints, but they are generally used for making

molds for castings having plain outlines, without sharp corners, cores, or projections.

Mold-boards.— Boards used for making molds for small castings having irregular joints. Their chief advantage consists in the saving of time and labor in forming the joints. They are made of various kinds of material. The wooden mold-board is carved out in the desired shape of the joint. The plaster of Paris mold-board is used in cases where the pattern is very crooked, and where the other types cannot be made as cheaply, or to fit with the same amount of accuracy. The sand-and-composition mold-boards are the kind generally used, and obviate the necessity of ramming the sand. The composition consists of twenty parts of fine dry sand to one part of litharge, tempered with linseed oil. The match-plate is a form of mold-board.

Molding or Founding.— The making of molds for metal castings. The molds are made in sand, loam, and plaster of Paris, with or without the aid of patterns. There are three classes of molding — green-sand molding, in which damp sand is used, and the castings are made in damp molds, or in molds the surfaces of which have been "skin-dried;" dry-sand molding in which the damp sand molds are thoroughly dried in an oven preparatory to casting; and loam molding. See Loam Work.

Molding Sand.— Sand is used for molding, in preference to all other materials, on account of its refractory nature, which enables it to resist the destructive action of molten metal at high temperatures; on account of its porosity, which allows the free escape of the gases generated in casting; and on account of its peculiarly compact and adhesive properties, which not only permits of its being molded to any desired shape, but also enables it to resist a great amount of pressure exerted by a liquid. The best molding sand is obtained from the coal measures, and the later red sandstone formations. Sand from the green-sand and chalk formations is also very satisfactory. The most suitable sand is that which contains a large percentage of silica, with alumina and magnesia present in small quantities. The various grades of molding sand are designated as green-sand, dry-sand, core-sand, facing-sand, and parting-sand, according to the purposes for which they are used.

Odd Sides.— See Mold-boards.

Parting.— The act of separating the different parts of a mold-box. Also applied to the process of making the sand-joint between two contiguous mold-boxes. Also to the joint itself.

Pouring.— The filling in of a mold with molten metal in making a casting.

Print.— A projection placed upon a pattern to indicate the position of a cored hole, and to form an indentation for the reception of the end of the core. "Pocket-prints" and "parallel-prints" are used at the sides of the patterns.

Rapping.— The process of loosening a pattern from the sand previous to its withdrawal therefrom. This is effected by inserting the pointed end of the "rapping-bar" into the "rapping-hole" bored in the pattern or in a plate of malleable iron called the "rapping-plate," screwed on the face of the pattern. Small round-faced wooden mallets, called "rapping-mallets," are used in the actual process of withdrawal, which, unless carefully performed, will not only damage the pattern, but will enlarge the molds of small castings to a very appreciable extent.

Riddle.— A coarse sand sieve of about half-inch mesh, used for sifting coarse and old sand.

Riser or Air Gate.— A vertical opening which extends from the mold, through the cope, to the outer air. When it fills up with the molten metal it indicates that the mold itself is full.

Tempering.— In foundry work, it is applied to the process of mixing various grades of sand. In forge shop work, it signifies the imparting of a definite degree of hardness, or elasticity to steel. It is effected by either raising or letting down the metal to a certain temperature and then cooling it from that temperature by plunging it in water or oil. The degree of temperature is indicated by the various colors assumed by the steel during the heating part of the process. It may also be determined by the flashing point of a fat.

Venting.— The piercing or honeycombing of the sand of a mold by means of a long wire-rod, one-eighth or one-quarter inch in thickness, thrust in all directions, for the purpose of allowing the free escape of the gases generated by the decomposition of the moisture in the sand by the heat of the inflowing metal.

For further information relative to the various processes such as riveting, welding, boring, etc., which form an important part of foundry and forge shop work, see articles under the titles, Boiler Shop Terms, and Workshop Terms, in this Encyclopedia.

William Morey, Jr., C. E.
Consulting Civil and Mechanical Engineer.

Fountain, or **Artificial Fountain,** in hydraulics, a machine or contrivance by which water is violently spouted or darted up; called also a *jet d' eau.* There are various kinds of artificial fountains, but all formed by a pressure of one sort or another on the water, namely, either the pressure or weight of a head of water, or the pressure arising from the spring and elasticity of the air, etc. When these are formed by the pressure of a head of water, or any other fluid of the same kind with the fountain or jet, then will this spout up nearly to the same height as that head, abating only a little for the resistance of the air, with that of the adjutage or pipe from which the water spouts, etc., in the fluid rushing through; but when the jet is produced by any other force than the pressure of a column of the same fluid with itself, it will rise to such a height as is nearly equal to the altitude of a column of the same fluid, whose pressure is equal to the given force that produces the fountain. In ancient Greece every principal town had public fountains or conduits, some of which were of handsome design and of beautiful execution. In the city of Megara there was a public fountain established by Theagenes, which was celebrated for its grandeur and magnificence. The fountain of Pirene, a fountain at Corinth, was encircled by an enclosure of white marble, which was sculptured into various grottoes, from which the water ran into a splendid basin of the same material. Another fountain in Corinth, which was called Lerna, was encircled by a beautiful portico, under which were seats for the public to sit on during the extreme heat of summer to enjoy the cool air from the falling waters. In the sacred wood of Æsculapius, at Epidaurus, there was a fountain that Pausanias cites as remarkable for the beauty of its decorations. At Messina there were also two elegant fountains, one called Arisinoë and the other Clepsydra. Pausanias also alludes to several other fountains in various parts of Greece, celebrated for the grandeur and beauty of their architectural and sculptural decorations.

The ancient fondness for fountains still exists in Italy and the East. The French are celebrated for their fountains, but Italy, more particularly Rome, is still more so. The fountains of Paris and of the Tuileries, of the orangery at Versailles, at St. Cloud, and other places in the neighborhood, are splendid structures. The principal and most admired fountains at or near Rome are those in front of St. Peter's, of the Villa Aldobrandini at Frascati, of the Termini, of Mount Janiculum, of the gardens of the Belvedere, in the Vatican, of the Villa Borghese, which has also in the audience chamber a splendid fountain of silver, five Roman palms in height, ornamented with superb vases and flowers; the fountains of Trevi, the three fountains of St. Paul, of the Aqua Acetosa, etc.

In the United States the ornamental type of fountain is the one in common use. Large display fountains were attractive features of the Centennial Exhibition, and at the Chicago World's Fair and Buffalo Pan-American Exposition. Among these was the Fountain of the Republic of Chicago, which was

designed by MacMonnies, and at Buffalo were costly examples dedicated to Man, Nature, Progress, etc. In Central Park, New York; Fairmount Park, Philadelphia; Lincoln Park, Chicago; Golden Gate Park, San Francisco, and other large parks, will be found numerous fountains of elaborate design. In all the larger cities drinking fountains for men and animals have been erected by individuals and local humane societies.

Fountain Pens. See LITERARY LABOR-SAVERS.

Fountains Abbey, one of the largest and best-preserved monastic edifices in England, in the West Riding of Yorkshire, 3 miles southwest of Ripon. Founded for Cistercians in 1132, it was not completed till the 16th century, and thus presents examples of every variety of style, from Norman to Perpendicular.

Fouqué, Friedrich Heinrich Karl, frēd'rĭh hīn'rĭh kärl foo-kā', BARON DE LA MOTTE, German poet and novelist: b. Brandenburg 12 Feb. 1777; d. Berlin 23 Jan. 1843. He was a grandson of H. A. Fouqué (q.v.); served as lieutenant of the Prussian guards in the campaign of 1792, and was present in 1813 at the most important battles in the War of Liberation. As a writer he is remarkable both for variety and fecundity, and has published poetry in almost all its forms — dramatic, epic, romantic, etc. Several of his short romantic tales in prose, such as 'Der Zauberring,' 'Aslauga's Ritter,' but more especially his 'Undine,' enjoy an extraordinary popularity. The last mentioned tale, a charming mixture of fairy ideality, the reality of humble life, and the glow of chivalry, has gone through many editions, and has been translated into every European language. It must be admitted that Fouqué, while possessing many of the virtues of the romantic school, was guilty of all its extravagances, and that the descriptions of chivalric and feudal life, in which he delighted, are mere fancy pictures.

Fouqué, Heinrich August, hīn'rĭh ow'goost, BARON DE LA MOTTE, Prussian general; b. The Hague, Holland, 4 April 1698; d. Brandenburg 2 May 1774. Fouqué possessed the confidence of Frederick the Great; and the 'Mémoires du Baron de la Motte Fouqué' (1788, by Büttner, the secretary of Fouqué), which contain his correspondence with Frederick the Great, are of great interest.

Fouquet, foo-kā, **Nicolas,** French statesman, VISCOUNT DE MELUN AND DE VAUX, AND MARQUIS OF BELLE ISLE; b. Paris 1615; d. Pignerol 23 March 1680. He received in 1650 the important appointment of procureur-général to the parliament of Paris, and three years later was advanced to be superintendent of finance. His rapid advance made him ambitious of succeeding Mazarin as first minister, but he had a formidable rival in Colbert. Fouquet's plans were, however, brought to naught; for in the first place Louis himself took the reins of power into his own hands when they slipped from the grasp of the dead cardinal, and in the second place, instigated thereto by Colbert, he suddenly arrested Fouquet in September 1661. After a trial extending over three years, Fouquet was sentenced to perpetual exile and the loss of all his property, but the sentence was afterward altered to life-long imprisonment. From the circumstance of his imprisonment at Pignerol, Fouquet, in spite of the fact that he died in 1680, has been identified with the Man With the Iron Mask (q.v.), who, however, lived till 1703.

Fouquier, foo-kē-ā, **Henry,** French publicist: b. Marseilles 1 Sept. 1838. After study of law and medicine he became a journalist in Paris, general-secretary of the prefecture of Marseilles (1870), and director of the press in the ministry of the interior. He wrote much for the *Figaro* and *XIX. Siècle,* but particularly for *Gil Blas,* under the pen-names "COLOMBINE" and "NESTOR," and was a founder of the *Echo de Paris.* In 1889 he was elected deputy for Alpes-Maritimes. His articles have been collected in several volumes under such titles as 'Etudes Artistiques' (1859); 'Au siècle dernier' (1884); 'La sagesse parisienne' (1859).

Fouquier-Tinville, Antoine Quentin, äṅ-twäṅ kĕn-tăṅ foo-kē-ā tăn-vēl, French revolutionist: b. Hérouelles, near St. Quentin, 1747; d. Paris 7 May 1795. As a member of the revolutionary tribunal he distinguished himself by his alacrity in pronouncing the verdict of guilty, and attracted the attention of Robespierre, who gave him the office of public accuser before this tribunal. The victims now became numberless. Fouquier drew up the scandalous articles of accusation against the queen, Marie Antoinette. His thirst for blood seems to have been increased by gratification, until it became a real insanity. He proposed the execution of Robespierre and all the members of the revolutionary tribunal 9th Thermidor, 1794, was himself removed on the 14th Thermidor (1 Aug.), 1794, and arrested. He died under the guillotine. There does not appear to be a trait in the life of this monster which can entitle his crimes to the same palliation as those of Robespierre, who considered the extermination of the aristocracy as a necessary evil. Consult Domenget, 'Fouquier-Tinville, et le tribunal révolutionnaire' (1878).

Four-eyed Fish, a fish of the genus *Anableps.*

Four-horned Antelope, or **Chousingha,** the genus *Tetraceros* of the antelope group, native to India, and differing from all other living ruminants in that the male generally bears two pairs of horns. It is closely related to the African duikerbok (q.v.), which it resembles in the position of its larger horns, and the shape of its eyes, as well as in other ways. The smaller horns rise from just above the eyes. This antelope is a pretty, brownish creature, standing about 25 inches at the withers, and is found from the foot of the Himalayas southward over India, in wooded hill-country, but it avoids dense jungles. It drinks daily, and hence never wanders far from the water. It is exceedingly shy, and escapes, when discovered, in a series of jerky, though very rapid, bounds, into the cover of long grass or low bushes.

Four Lakes, a chain of lakes in Dane County, Wis.; known respectively as First, Second, Third, and Fourth lakes. First Lake, the smallest and lowest of the chain, is about 3 miles long by 2 miles wide; Second Lake is 3½ miles long by 2 broad; Third Lake is 6½ miles long by 2 miles wide; Fourth Lake, the largest and most beautiful, is 6 miles long by 4 wide. The waters of these lakes are navigable for small steamers. The two last are now called lakes Monona and Mendota.

Four-o'clock. See FRIAR-BIRD.

Fourcroy, Antoine François de, äṅ-twän fräṅ-swä dė foor-krwä, French chemist: b. Paris 15 June 1755; d. 16 Dec. 1809. Having adopted the profession of medicine he applied himself closely to the study of the sciences connected with it, especially to chemistry, and published in 1776 a translation of Ramazzini's 'Treatise on the Diseases of Artisans.' He was professor of chemistry at the Jardin du Roi, 1780-1805. He organized the central school of public works, out of which the polytechnic school afterward sprang, and co-operated in the establishment of the normal schools. In 1799 Bonaparte gave him a place in the council of state, in which place he drew up a plan for a system of public instruction, which, with some alteration, was adopted. His works are numerous, among which the following are the most important: 'Leçons Elémentaires d'Histoire naturelle et de Chimie' (1791); 'Système des Connaissances chimiques, et de leurs Applications aux Phénomènes de la Nature et de l'Art' (1805); 'Philosophie chimique'; 'Tableaux synoptiques de Chimie' (1805); and 'La Médecine éclairée par les Sciences physiques.'

Fourdrinier (foor-drĭ-nēr') **Machine,** a paper-making machine, the first to make a continuous web. It was invented by Louis Robert, of Essonne, and patented by him in France. A Mr. Gamble and the brothers Fourdrinier improved it. The machine was perfected by others.

Fourier, François Charles Marie, fräṅ-swä shärl mä-rē foo-rē-ā, French social economist: b Besançon 7 April 1772; d. Paris 10 Oct. 1837. He studied at the college in his native town, and obtained a mercantile position at Rouen; he later entered into business on his own account at Lyons, having inherited a small fortune from his father, but the siege of the city by the troops of the convention in 1793 and the subsequent disorders were fatal to his prosperity; he was arrested and kept a prisoner for some time, and afterward served two years in the Revolutionary army. When he was 19, while employed at Marseilles, his employers retained a cargo of rice in order to keep up the price, and when it became unfit for use ordered Fourier to throw it into the sea. This experience led him to question the righteousness of the existing industrial system and to develop his own social theory known as Fourierism (q.v.). He first published 'Theorie des quatre Mouvements et des Destinées generales' (1808), in which he explained the basis of his system, which he developed more completely in 'Traite de l'Association domestique agricole' (1822), republished under the title 'Theorie de l'Unité universelle,' and in 'Le Nouveau Monde' (1829-30). See Pellarin, 'Charles Fourier, sa vie et sa théorie' (5th ed. 1871; American translation, 1845).

Fourier, Jean Baptiste Joseph, zhöṅ bäp-tēst zhō-zĕf, BARON, French mathematician: b. Auxerre, France, 21 March 1768; d. 16 May 1830. He was an active Jacobin during the French Revolution. His later energies were divorced from politics and given up to science. 'Analytical Theory of Heat' (1822) is his most noted work; but in mathematics his speculations and methods are of high permanent utility.

Fourierism, foo'rĭ-ėr-ĭzm, the social system advocated by F. M. C. Fourier (q.v.). It was based on the theory that the social order depends upon fixed moral and intellectual laws, and that man must discover and live according to these laws. According to Fourier society must be so organized as to give freedom to the passions or desires of man, since these are naturally capable of harmony, and, if developed under proper conditions, would, in accordance with the law of attraction, lead to a perfect society. In this society industry should be carried on by phalanxes, each phalanx to be divided into series, and the series combined in groups; each group was to have charge of one kind of work, and each series of one special branch of that work. In the distribution of products a certain minimum was to be assigned to each member of the society, whether capable of labor or not; the remainder to be shared in certain proportions to be previously determined among the three elements, labor, talent, and capital. The capital of the community might be owned in unequal shares by different members of the community; inheritance was to be permitted, and the individuals could expend the remuneration they received as they pleased. The government was to be republican, with elective officers. Fourierism, though socialistic, is not properly socialism, and is related to modern socialism by its sharp criticism of existing conditions, rather than by its plan for the future of society.

Fourierism won many converts in France; among those who advocated the theory were Victor Considerant and Mennier; an association was formed; a periodical, the 'Phalange,' was published for a short time; and a number of communities were organized in accordance with the Fourieristic plan, none of which long survived. Fourierism was introduced into the United States in 1842, by Albert Brisbane, who for a time published 'The Phalanx,' in New York. He was welcomed by the members of the Brook Farm community, and the Fourieristic organization was adopted there. For a time the 'Brook Farm Phalanx' published 'The Harbinger,' the most important periodical published by the Fourierists in the United States. An organization, known as the American Union of Associationists, was formed for the "popular diffusion of the principles of the associative sciences as discovered by Charles Fourier, with a view to their ultimate realization by the establishment of phalanxes." Horace Greeley (q.v.) became its president, and George Ripley (q.v.) secretary. A large convention of the "associationists" was held in New York in 1844. In 1847 'The Harbinger' was transferred to New York under the charge of this association, and was published till 1849. About 34 communities were organized by the Fourierists, of which the most important (besides Brook Farm) were the North American Phalanx, which lived 12 years, and the Wisconsin Phalanx. Most of them existed but a short time, and by 1850 the Fourierist movement had practically come to an end. Consult: Brisbane, 'Social Destiny of Man'; Ely, 'French and German Socialism'; Noyes, 'History of American Socialisms'; Shaw, 'A Forgotten Socialism' ('New England Magazine,' new series Vol. VIII., p. 773). See BROOK FARM; COMMUNISM; NORTH AMERICAN PHALANX; SOCIALISM.

Fourier Series, in mathematics, a trigonometric series first extensively employed by the French mathematician Jean Baptiste Joseph

Fourier, in connection with the theory of the movement of heat in a solid body. It was primarily intended for effecting the development of an arbitrary periodic function in the form of a series whose terms are sines and cosines of increasing multiples of the variable. The subject is too technical for discussion in a general encyclopædia. Consult: Fourier, 'The Analytical Theory of Heat' (translated by Alexander Freeman); and more especially, Byerly, 'An Elementary Treatise on Fourier's Series, and Spherical, Cylindrical, and Ellipsoidal Harmonics.'

Fourth Nerve, one of the pair of cranial nerves, and the chief motor nerve of the superior oblique muscle of the eye. It originates in a group of cells in the floor of the medulla and runs outward over the superior elevator muscle of the eyelid, and is distributed to the orbital surface of the superior oblique.

Fourth State of Matter. See ELECTRON; MATTER; RADIUM.

Foussa. See FOSSA.

Fouthill Abbey. See BECKFORD, WILLIAM.

Fouke (originally **Smith**), **Gerard,** American archæologist: b. Maysville, Ky., 25 June 1855. In 1885–8 and 1891–3 he was connected with the United States Bureau of Ethnology in surveys and explorations of aboriginal remains in the eastern part of the country. Further research by him includes explorations for the American Museum of Natural History, New York, on the lower portion of the Amur River, Siberia, and on Vancouver's Island, British Columbia; and excavations of so-called Norse remains in the vicinity of Boston, Mass. His published writings comprise essays on archæological subjects in the bulletins and reports of the Bureau of Ethnology and elsewhere.

Fowl, a word originally synonymous with bird, now used in a stricter sense to designate the genus *Gallus,* of which the common domestic fowl (cock and hen) is a familiar example. The general form and characters of the bill, feet, etc., agree with those of the pheasants, but the crown of the head is generally naked and furnished with a fleshy comb, the base of the lower mandibles also bearing fleshy lobes or wattles — characters which are most conspicuous in the males. The jungle fowl of India (*Gallus ferrugineus,* or *bankiva*) is regarded as the source of domestic poultry; it is known also in southern China and throughout the Malay islands. The male closely resembles the game-cock. The comb and wattles are of the brightest scarlet, the long hackles of the neck and lower parts of the back are fine orange-red, the upper part of the back is deep blue-black, and the shoulders ruddy chestnut. The long, arched, and drooping tail is blue-black, glossed with green, and the breast and under parts black. The word is also commonly applied in such combinations as wildfowl, waterfowl, seafowl, and the like. For the characteristic of domestic fowls, see POULTRY.

Fowler, Charles Henry, American Methodist clergyman: b. Burford, Ontario, Canada, 11 Aug. 1837. He was graduated at Genesee College in 1859 and at the Garrett Biblical Institute in 1861; studied law; was pastor for 11 years in Chicago, Ill.; president of the Northwestern University in 1872–6; and corresponding secretary of the Missionary Society in 1880. He was elected a bishop of the Methodist Episcopal Church in 1884; visited Japan, Korea, and China in 1888; organized the Peking and Nanking universities; was stationed for eight years on the Pacific coast; founded the Maclay College of Theology in Southern California, and assisted in founding Wesleyan University in Lincoln, Neb. He was sent as a fraternal delegate to the Wesleyan Conference in Great Britain in 1898.

Fowler, Ellen Thorneycroft, English novelist. She is the daughter of Sir Henry Fowler, secretary of state for India 1894–5. Her published works include: 'Verses Grave and Gay' (1891); 'Verses Wise and Otherwise' (1895); 'Concerning Isabel Carnaby' (1898); 'A Double Thread' (1899); 'The Farringdons' (1900); 'Love's Argument' (1900); 'Sirius, and Other Stories' (1901); 'Fuel of Fire' (1902).

Fowler, Frank, American artist: b. Brooklyn, N. Y., 12 July 1852. He studied at Florence as pupil of Edwin White, at Paris with Carolus Duran and in the Beaux-Arts, established a studio at New York in 1880, and became known as a portrait painter. His subjects include S. J. Tilden, Archbishop Corrigan, C. A. Dana, and other notabilities. He was elected a National Academician, and has published manuals of art: 'Oil Painting'; 'Drawing in Charcoal and Crayon'; 'Portrait and Figure Painting.'

Fowler, Sir John, English civil engineer: b. near Sheffield 1817; d. London 20 Nov. 1898. In 1844 he was appointed to superintend the construction of the Manchester, Sheffield, and Lincolnshire system, a connected group of railways, and other works of vast extent and complexity. He subsequently was employed on many civil engineering works both in England and elsewhere; but the work with which his name will probably be most lastingly connected is the great bridge across the Forth, of which he was chief engineer, having as his colleague Sir Benjamin Baker. (See BRIDGE.) On its completion in 1890 he was made a baronet.

Fowler, Joseph S., American lawyer: b. Steubenville, Ohio, 31 Aug. 1820. He became professor of mathematics at Franklin College, Tenn., and was president of the Howard Female College in Gallatin, Tenn., in 1856–61. Subsequently he was State comptroller under Andrew Johnson, and was a United States senator 1866–71. In 1871 he retired from political life and engaged in law practice in Washington, D. C.

Fowler, Lorenzo Niles, American phrenologist: b. 1811; d. 1896. He was a brother of Orson Squire Fowler (q.v.). From 1863 he resided in England. He was a publisher of the 'Science of Health' (originally the 'Water-Cure Journal') and the 'American Phrenological Journal,' and wrote 'Phrenology and Physiology' (1844).

Fowler, Montagu, English Anglican clergyman: b. London 12 Nov. 1858. He was educated at Harrow and Cambridge; took orders in the Established Church, was vicar of St. Lawrence, Isle of Thanet, Kent, 1889–93, and has been rector of All Hallows, London Wall, from 1900. He has published: 'Christian Egypt'; 'Some Notable Archbishops of Canterbury'; 'Church History in Queen Victoria's Reign.'

Fowler, Orson Squire, American phrenologist: b. Cohocton, Steuben County, N. Y., 11 Oct. 1809; d. Sharon, Conn., 18 Aug. 1887. He was graduated at Amherst College in 1834, and opened a phrenological office in New York in 1835. In 1836 he and his brother Lorenzo wrote and published 'Phrenology Proved, Illustrated and Applied,' and in 1838 issued the first number of the 'American Phrenological Journal.' Subsequently he lectured on his specialty and allied subjects in the United States and Canada, and wrote and published numerous books, including 'Self-Culture and Perfection of Character'; 'The Self Instructor in Phrenology'; 'Human Science'; etc.

Fowler, Thomas, English philosopher: b. Burton-Stather, Lincolnshire, 1 Sept. 1832. He was educated at Merton College, Oxford, and from 1873 to 1889 was professor of logic in the university. Since 1881 he has been president of Corpus Christi College. His published works include: 'Elements of Deductive Logic' (1867; 10th ed. 1892); 'Elements of Inductive Logic' (1870; 6th ed. 1892); an edition of Bacon's 'Novum Organum,' with introduction and notes (1878; 2d ed. 1889); a little work on 'Locke' (1880); an edition of Locke's 'Essay on the Conduct of the Understanding' (1881; 3d ed. 1890); 'Francis Bacon' (1881); 'Shaftesbury' (1882); 'Hutcheson' (1882); 'Progressive Morality: an Essay in Ethics' (1884; 2d ed. 1895); 'History of Corpus Christi College, Oxford' (1893); 'Principles of Morals' (Part I., introduction written with J. M. Wilson, 1885; Part II., the body of the work, by Prof. Fowler alone, 1887; both in one volume, revised 1894); and 'Popular History of Corpus Christi College' (1898).

Fowler, William Warde, English ornithologist: b. Somerset 1847. He was educated at Marlborough College and Oxford, and has been sub-rector of Lincoln College, Oxford, from 1884. He has published: 'A Year With the Birds' (1886); 'Tales of the Birds' (1888); 'Life of Julius Cæsar' (1892); 'The City-State of the Greeks and Romans' (1893); 'Summer Studies of Birds and Books' (1895); 'The Roman Festivals of the Republican Period' (1899); 'More Tales of the Birds' (1902).

Fowler, William Worthington, American author: b. Middlebury, Vt., 24 June 1833; d. Durham, Conn., 18 Sept. 1881. He was the author of 'Ten Years in Wall Street' (1870); 'Fighting Fire' (1873); 'Woman on the American Frontier' (1877); 'Twenty Years of Inside Life in Wall Street' (1880).

Fowler's Solution. See ARSENIC.

Fox, Charles James, English statesman: b. London 24 Jan. 1749; d. Chiswick, Surrey, 13 Sept. 1806. He was the son of Henry, 1st Lord Holland, and was educated at Eton and Hertford College, Oxford. His father procured him a seat for the borough of Midhurst in 1768 before he was of legal age, and in 1770 the same interest procured him the office of one of the lords of the admiralty, which post he resigned in 1772, and was appointed a commissioner of the treasury.

After being a supporter of the administration for six years, Fox was ejected owing to a quarrel with Lord North, and was thrown into the ranks of the Opposition. The adoption of the disastrous measures which terminated in the independence of the American colonies enabled him to take this part without opposing any of the policy which he had previously supported. During the whole of this eventful contest he spoke and voted in direct opposition to the ministerial system, and, in conjunction with Burke, Barré, Dunning, and other eminent parliamentary leaders, displayed the highest talents both as a statesman and orator. On the final defeat of the administration of Lord North and the accession of that of the Marquis of Rockingham, Fox obtained the office of secretary of state for foreign affairs. But the death of the Marquis of Rockingham suddenly divided the party, and on the Earl of Shelburne becoming first lord of the treasury Fox retired and soon after a union took place between his friends and those of Lord North, under the name of the coalition. The temporary success of this party movement served only to render popular disgust the more general; and the dismissal of the coalition excited general satisfaction. Though in the new Parliament Pitt had a decided majority, Fox headed a very strong opposition, and political questions were for some years contested with a display of talent on both sides which the House of Commons had seldom previously exhibited.

In 1790 and 1791 Fox regained a share of popularity by his opposition to war with Spain and Russia, and also by his libel bill, regulating the rights of juries in criminal cases and rendering them judges both of the law and the fact. On the breaking out of the French Revolution he was disposed to regard it as likely to prove extremely beneficial. The contrary views of Burke, and the extraordinary manner in which that ardent politician on that account publicly renounced his friendship, is one of the most striking incidents in parliamentary history.

The opinions formed of this eminent leader as a practical and theoretical statesman have been as various as the shades of party difference. That he was a sincere friend to all the broad and generous principles on the due development of which rest the freedom and best interests of mankind, is not to be doubted, and that they were alloyed by great latitude on the subject of party and political expediency is equally clear. As a powerful and purely argumentative orator he was of the very first class; though as to eloquence and brilliancy he perhaps yielded to Pitt, Burke, and Sheridan; nor were his voice and manner prepossessing, though highly forcible. Of his amiability in private life, after making allowance for a dissipated youth, all accounts agree. Friends and foes equally testify to his ingenuous and benign character. As an author, besides some Latin poetry and a Greek dialogue, by which he highly distinguished himself at Eton, and a few numbers of a paper, entitled 'The Englishman,' he published nothing during his lifetime but 'A Letter to the Electors of Westminster' (1793). To his nephew, Lord Holland, the world is indebted for his posthumous publication, entitled 'The History of the Early Part of the Reign of James II.' It is written with unpretending simplicity, but disappointed expectation, and has never been popular. See Lord John Russell, 'Life and Times of C. J. Fox' (1859–66); Wakeman, 'Life of Charles James Fox' (1890); Trevelyan, 'Early History of Charles James Fox' (1881).

Fox, George, English religionist, founder of the Society of Friends: b. Drayton, Leicestershire, England, July 1624; d. London 13 Jan. 1690. While yet a boy he was distinguished by his gravity and exemplary conduct. When in the 20th year of his age, and for some two or three years afterward, Fox describes himself as having been in a distressed state of mind, but from this condition he was at length delivered by that which he regarded as the voice of God in his soul, directing him to Christ as alone able "to speak to his condition." Very soon after this he commenced his public ministrations at Dukinfield, Manchester, and the neighborhood. From the first his preaching seems to have made many converts and excited much opposition. Fox's first imprisonment took place in the year 1648, in consequence of his opposing the preacher in "the great steeple-house at Nottingham," on a point of doctrine. In 1650 he was imprisoned at Derby under a false charge of blasphemy. One of the committing justices, Bennet, acted with great violence on this occasion, and it was he who on Fox's bidding him "tremble at the word of the Lord" first applied to him and his friends the name of Quakers. Fox lay in prison at Derby for about a year, the time having been lengthened in consequence of his refusal to accept a commission as captain of one of the regiments then being raised by Parliament. To his belief of the unlawfulness of all war, which prompted this refusal, was added at the same time a clear view of the enormity of the punishment of death for crimes affecting property only, and he exerted himself to save the life of a poor woman then in jail for theft. Within 10 years of Fox's appearance as a preacher, meetings of the Friends were established in most parts of England. At the same time, so actively were they persecuted, that for many years there were seldom less than 1,000 of them in prison. Cromwell, though himself favorable to liberty of conscience, seems to have been unable to curb the excesses of popular hostility launched in all quarters against a sect which denounced all state interference with religion and maintained that the gospel should be preached without fee or reward. About a month after the restoration of Charles II., Fox was committed to Lancaster Castle, "on the charge of being a common disturber of the peace, and of endeavoring to make insurrection and embroil the whole kingdom in blood." After lying in jail some months, a habeas corpus was obtained, and the authorities showed their disbelief of these grave charges by allowing Fox himself, unbailed and unguarded, to convey to London the sheriff's return to the writ. The hopes entertained by the members of the young society that they would be allowed a breathing-time from persecution were dispelled at the commencement of 1661 by the atrocious measures which followed the mad attempt of Venner and his Fifth-Monarchy men. The act empowering magistrates to tender the oaths of allegiance and supremacy to any person whom they thought fit to suspect, also operated with great severity against the Friends; under its provisions Fox was committed to prison at Lancaster in the beginning of 1664, whence he was removed to Scarborough Castle, where he lay till the autumn of 1666. In 1669 Fox married Margaret Fell, the widow of one of the judges of the Welsh courts. The year 1670 witnessed the passing of the most stringent of the Conventicle Acts, forbidding under heavy penalties the assembling for religious worship, in any house, of more than four persons besides the family, except according to the usages of the Church of England. Soon after his recovery from a severe illness he sailed for Barbadoes, where he exerted himself greatly in the interests of religion and humanity. It was while in this island that Fox drew up a statement of his own and his friends' belief in all the great doctrines of Christianity — a statement clearly disproving their alleged sympathy with Socinian tenets. After a considerable time spent in Barbadoes, Jamaica, and the North American continent, he returned to England in 1673, where further persecutions awaited him. He underwent 14 months' imprisonment in Worcester jail, and was at length liberated by the Court of King's Bench on account of the errors in his indictment. In 1677, in company with Penn and Barclay, who had joined the Society about 10 years before, he paid a visit to Holland and some parts of Germany, where his services seem to have been well received. The last 15 years of his life were tranquil as regards personal molestation, but he continued to be actively engaged in various ways in promoting the welfare of his brethren. Their persecutions continued throughout the reign of Charles II. In the first year of William and Mary was passed the bill which nullified the Conventicle Acts, and allowed the Friends to make a solemn declaration in lieu of taking the oaths, and Fox had the gratification of seeing the public worship of the Society legally recognized before his death. (See FRIENDS, SOCIETY OF.) His works were issued in three volumes 1694–1700. Consult: Sewell, 'History of the Quakers'; Lives by Marsh (1848); Janney (1853); Watson (1860); Tallack, 'George Fox, the Friends and the Early Baptists' (1868); Bickley, 'George Fox and the Early Quakers' (1884).

Fox, George L., American actor: b. Boston, Mass., 3 July 1825; d. 24 Oct. 1877. He first appeared at the Tremont Street Theatre in the 'Hunter of the Alps'; became known as a low comedian at the National Theatre, New York; was a lieutenant in the Union army at Bull Run, and later became manager of the New Bowery Theatre. Here he gained for himself a distinct position by his burlesque imitations of favorite tragedians of the time, and his pantomimes, the best of which was 'Humpty Dumpty,' in which from 1867 to his retirement in 1876 he appeared as the clown.

Fox, Gustavus Vasa, American naval officer: b. Saugus, Mass., 13 June 1821; d. New York 29 Oct. 1883. He was appointed to the United States navy in 1838, in which he served till 1856, when he resigned with the rank of lieutenant. He was subsequently appointed assistant secretary of the navy, and held this post till the end of the Civil War. He planned a number of operations for the navy, including the capture of New Orleans; and was sent by the government on the Monitor Miantonomoh to convey the congratulations of Congress to Alexander II., on his escape from assassination. His visit to Russia materially aided the acquisition of Alaska by the United States, and was the longest voyage then made in a monitor.

Fox, John William, American novelist: b. Bourbon County, Ky., 1863. He was graduated

from Harvard 1883 and has published: 'Hell for Sartain and Other Stories' (1897); 'A Mountain Europa' (1899); 'The Kentuckians' (1898); 'Crittenden' (1900); 'Blue Grass and Rhododendron' (1901); 'The Little Shepherd of Kingdom Come' (1903).

Fox, Margaret, American spiritualist: b. Bath, Canada, 1836; d. Brooklyn, N. Y., 8 March 1893. She was about 12 years old when her family were startled by mysterious rappings. All endeavors to trace them to any physical source proved unavailing. Various experiments were tried, but the "occult" power refused to act save in the presence of Margaret and her sister Leah. The family moved to Rochester, N. Y., but the raps followed and heavy bodies were moved without appreciable agency. In 1849 the sisters appeared in a public hall; when the same phenomena were freely manifested and tested. In 1850 the two girls went to New York, the "manifestations" became the subject of public discussion, and "mediums" sprang up all over the country. In 1888 Margaret made a public exposure of her pretended "manifestations," which she subsequently contradicted.

Fox, William Carlton, American diplomatist: b. St. Louis, Mo., 20 May 1855. He first came into prominence as United States consul at Brunswick, Germany (1876–88). Subsequently he was United States vice-consul-general at Teheran, Persia. He organized the American Missionary Hospital during the cholera epidemic there in 1892, and established and edited the only strictly diplomatic and consular journal ever attempted in the United States.

Fox, William Freeman, American forester: b. Ballston Spa, N. Y., 11 Jan. 1840. He was graduated at Union College in 1860; studied engineering; served in the Civil War; and subsequently took charge of the Department of Forestry of New York State. He is the author of: 'Regimental Losses in the Civil War'; 'The Adirondack Spruce'; 'State Forestry Reports' for 1885–1901; and magazine articles on forestry, etc.

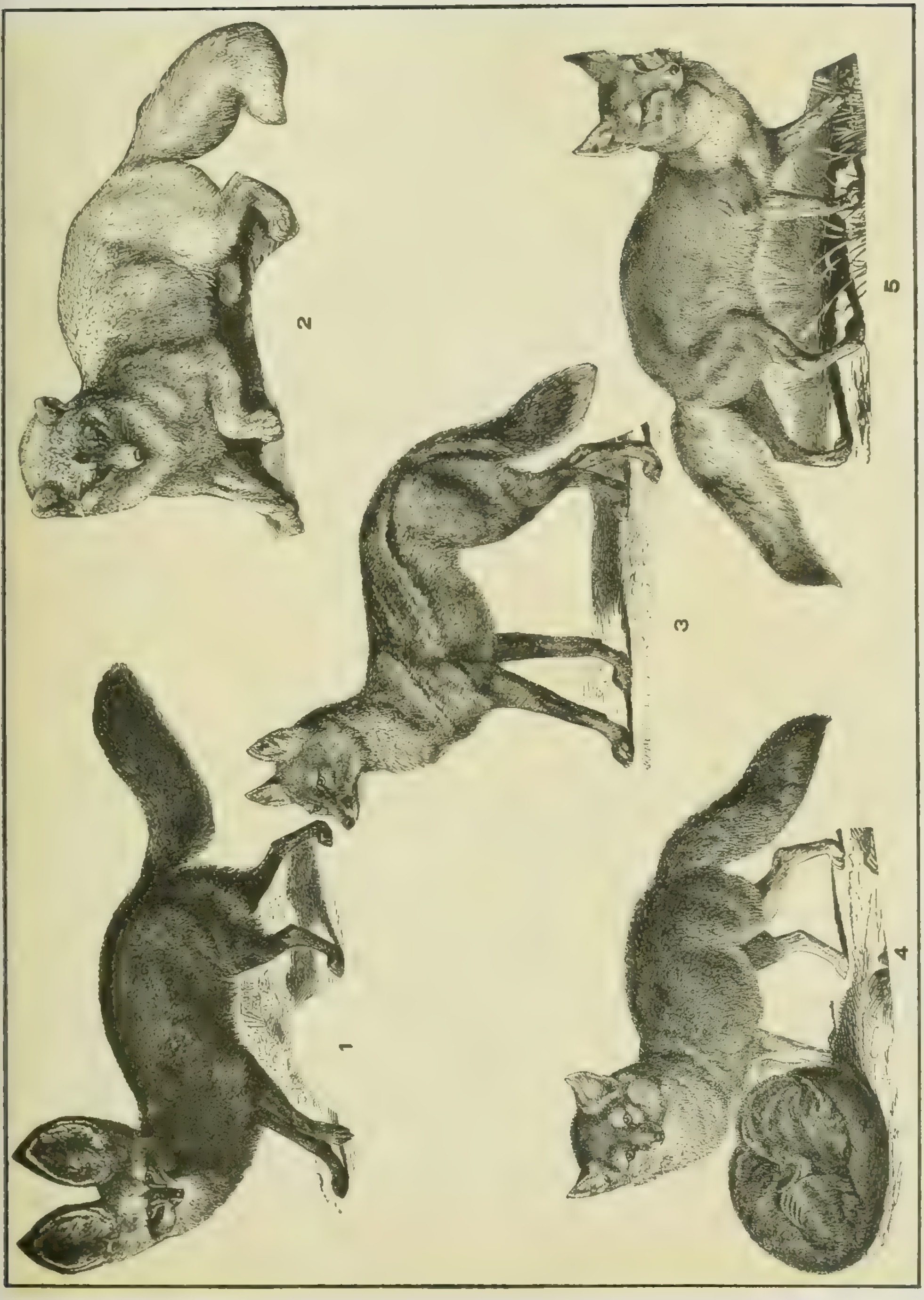
Fox, William Johnson, English orator and political writer: b. near Wrenthaum, England, 1786; d. London 3 June 1864. A weaver's son, he early showed signs of ability and was picked out to be educated for the Independent ministry. Once ordained, his rationalistic opinions cut him off from all the denominations. He became a radical active in politics, and spoke and wrote with persistent vehemence against the Common Laws. He was elected to Parliament in 1847, but was twice defeated at subsequent elections. His vigorous pen and eloquent voice aided the cause of popular social and political progress in England at a critical time in her history.

Fox, one of a group of small, long-eared, bushy-tailed animals of the dog-tribe (*Canidæ*), mostly included in the genus *Vulpes;* specifically, in literary usage, the red fox (*V. vulgaris*), called *renard* by the French and *reinicke fuchs* by the Germans. Foxes differ from wolves and jackals in being smaller, having shorter legs, longer, more furry and pointed ears, a more slender elongated muzzle, and a longer and more bushy tail; and they incline to that yellowish red color called "foxy." But these distinctions are difficult of limitation (see FENNEC; FOX-DOG), and some naturalists refuse to recognize a separate genus for them. One fixed character is found in the pupil of the eye, which when contracted becomes elliptical in the foxes but remains round in other dogs. All the typical foxes are inhabitants of northerly latitudes, and well represented by the common red fox, which may be regarded as distributed throughout the whole northern hemisphere, though variously named in different countries, where local diversities exhibit themselves; thus the American variety is called *V. pennsylvanicus,* but it is not essentially different from those of the Old World. Its variations are as great here as in Europe and Asia, especially among those of the Far North, where certain color-phases have superior value in the fur-trade. Thus a fox marked with a dark line along the spine and another over the shoulders, is called a "cross" fox, and fine specimens are worth an extra price. Wholly black ones are uncommon; but the rarest and most valuable pelt is that of a "silver" fox, that is, a black one in which so many hairs are white-tipped that a hoary or silvered appearance is given to the skin. The red fox is fostered for the sport of fox-hunting (q.v.) in Great Britain, and in some parts of Eastern America, but in most countries he is regarded merely as a fur-bearer, or a poultry thief or worse, and is trapped, shot and poisoned continuously. Nevertheless, the animal survives and multiplies in the midst of civilization, by virtue of its power of comprehension of and adaptation to new conditions; so that he has acquired, very justly, a reputation for alertness, wit and cunning in contrivance for food and safety. In America this species is constantly extending its range southward at the expense of the gray fox. Another species yielding a valuable fur is the Arctic or blue fox (*V. lagopus*), which is found on all Arctic coasts, and although brownish in summer, becomes in winter pure white; but the under fur is always bluish, and in those of Alaska this color prevails over brown in summer. Certain of the Aleutian Islands have lately been devoted by local fur companies to the rearing of these foxes in semi-captivity, where they are cared for, and a selected number annually sacrificed to trade. North America has two other well-marked species. One is the swift or kit fox (*V. velox*) of the plains, which is only 20 inches long, exceedingly swift of foot, expert in digging and cunning at concealment. It has reddish-yellow fur in summer, but becomes dull gray in winter, with black patches each side of the nose. The other species is the gray fox, which was once generally distributed over the United States but has become extinct in the northeastern part since the general clearing and settlement of the country. It is a woodland animal, still numerous in the South and West. Its hair is stiffer and duller in color than that of the red fox, and it is so peculiar in structural respects (among others in having a concealed mane of stiff hairs on the top of the tail) that it has been classified in a separate genus as *Urocyon argenteus.* Several well-known species dwell in Asia, the best-known of which is the familiar fox of northern India (*V. bengalensis*).

Foxes everywhere are burrowing animals or else adapt to family needs holes in rocks, hollows of old stumps, and similar conveniences. They hide by day and go abroad at night in search of small prey, stalking and catching birds on their nests, or at roost on the ground. ground-

RED FOX

FOXES.



1. Cape Fox or Lalande's Dog. 2. Arctic Fox. 3. Side-striped Jackal or Quaha.
4. Silver Fox. 5. Corsac.

squirrels, mice, frogs, and insects, and also eating largely of certain roots, fruits and other vegetable food. They are hardy, hunt all winter and climb mountain peaks. They never hunt in packs, as do wolves; and their voice is nearer a bark than a howl. They do not readily submit to domestication, and seem to have contributed little if anything to the composition of domestic breeds of dogs.

Consult for information on Old World foxes, the writings of Bell, Brehm, Blanford, Mivart and Beddard, well-summed up in Lydekker's 'Royal Natural History,' Vol. I. For American foxes, read Richardson, Hearne, Audubon, Merriam, the writings of Nelson, Turner and Murdoch on the natural history of Alaska, and the general remarks in Cram and Stone's 'American Animals' (1902).

Fox Bats. See Flying-fox.

Fox Channel, in the Hudson Bay, Canada, named after Luke Fox, who explored the region in 1631. The channel lies between Southampton Island and Baffin Land.

Fox-dog, a name given by certain naturalists to the wild dogs of South America, because of their fox-like appearance. Among these are the crab-eating dog (*C. cancrivorous*); the zono, or Azara's dog (*C. azaræ*), of which the "colpeo" of the pampas and southward is probably a local variety; the small-eared Brazilian dog (*C. microtus*, of Mivart), and two other aberrant Brazilian dogs (*C. urostictus*, and *C. parvidens*) for which a separate genus (*Nothocyon*) has been proposed by Wortman. All these animals have a striking external resemblance in color and form to the foxes, and connect them with the typical dogs. They are not well known, however. Consult: Mivart in the 'Proceedings' of the Zoological Society of London (1890); Beddard, 'Mammalia' (1902), and writers upon the zoology of South America. See Bush-dog.

Fox-hound, a breed of hounds, concerning whose origin practically nothing is known, save that they were probably first bred in Great Britain. This, perhaps the handsomest and most perfect of all hounds, is essentially a field dog, presenting an eminently powerful, well-built appearance, with his clean-cut, compact body, and giving evidence of muscular strength and endurance in the hunt. The head is full, with a broad brow, a long, wide muzzle, and open nostrils. The ears are set low and lie close to the cheek. The eyes are soft and brown. The chest is broad, and the ribs are deep, so as to afford plenty of breathing space. The muscular body is set on legs as straight as a post, and very strong; and the feet are round and cat-like. The color varies from black to tan and white, and the coat is hard, smooth and glossy. The American breed is lighter and finer in lines than the English fox-hound, has longer, thinner, and more pendant ears; a slightly narrower chest, and a rougher coat. He is used in fox-hunting as is the English fox-hound; but is also employed in hunting the moose, and other large game, especially in the Canadian forests. See Dog.

Fox-hunting, the chase of the fox with horses and hounds, as a recreation. This sport arose in England with the Restoration, when changes in customs and agricultural conditions caused the disappearance of falconry, and has become surrounded by codes of social usage and of legal enactments. It flourishes most in the south-central counties of England, and in Ireland, and some of the principal organizations or "hunts" as the Belvoir, Quorn, Pytchley and Cottesmore, were founded early in the 17th century. A "hunt" is an association for the promotion and regular practice of the sport in a certain district. It acquires a pack or several packs of fox-hounds (q.v.), kennels and perhaps a club-house, is directed by a "master of fox-hounds," and served by paid employees, the principal of whom are the "huntsman" who arranges and leads the sport for the day, and the "whippers-in," who see that the dogs work properly. These officials, and the sportsmen themselves wear "pink" (that is scarlet) coats when in the field. The expenses are paid theoretically by annual subscriptions, eked out by casual subscriptions for temporary privileges, but usually they must be supplemented by a patron,— probably the "M. F. H.," who has inherited the dignity and its responsibilities from ancestors who founded the hunt. Anyone may join in the chase, and at Melton Mowbray and other famous "meets" large numbers of outsiders are often present. In these districts foxes are carefully preserved, and the abode and habits of each family of them are studied with reference to the autumnal and winter sport. At the appointed time the hunters, men and women, mounted and accompanied by a pack of from 25 to 40 hounds, are led by the huntsman toward the place where he expects to "find" a fox. There the dogs are loosed, and range about searching for the scent-traces in the air or on the ground left by the recent passage of the animal. When one finds a trail he gives tongue, the others come to his aid and the pack dash away following the scent. With a bugle-signal or cry of "Gone away!" the hunt follows as straight and fast as possible, keeping to roads, lanes, and gates where possible, but jumping fences and riding over grain-fields and meadows where needful, the hunt paying such damages as follow. This requires a horse of great speed and leaping power, and has developed the English thoroughbred hunter. When anyone catches sight of the fox he shouts "View! halloa!"; and the ambition of all riders is to keep close to the racing animals and be on the spot, or "in at the death," when the fox is seized. It is then the duty of the huntsman, or the nearest rider, to save the body of the fox from the dogs, cut off its "brush" (tail), "pads" (feet), and "mask" (head) to be given as trophies to the foremost riders. The remainder of the fox is cut up and given to the dogs on the spot. Instead of running "straight away" and leading a long chase the fox will often take refuge in a drain or other hole, unless it has been "stopped." This is called "going to earth," and he must then be ousted by the aid of a fox-terrier.

Fox-hunting has been carried wherever Englishmen have settled, but has found few parts of the world favorable to it. In some countries, as on the North American prairies, in California, and in the Argentine Republic, similar methods are adapted to the chase of other animals, as wolves or kangaroos. In the southern and eastern United States, however, where foxes abound, true fox-hunting has flourished ever since colonial days, when each man brought his own hound or hounds to the assembly; and

is still pursued by several established clubs in Virginia, Maryland, and southern Pennsylvania, where the nature of the country and the agricultural habits of the people favor it. These clubs employ a modified form of hound better adapted to the faster and rougher work required of it than would be the English breed. A special strain, the Magnes hound, has been fostered by the Maryland clubs, the foremost of which is the Elkridge. More nearly conforming to the English models is the establishment and hunting of the Meadowbrook Hunt, on Long Island, N. Y., where, in a level open country, largely occupied by extensive estates and within easy reach of New York, the sport has flourished since about 1876, and is likely to be long maintained.

An extensive and pleasing literature has grown up about this subject, and many thousands of titles would be required for its bibliography. A good general view may be obtained by reading the volumes devoted to the sport in the English 'Badminton Library' and in the American 'Sportsman's Library.'

Fox Indians (French name Renards, «foxes,» from their fox-totem; their own name Musquaki, «red-earthers»; Ojibwa name Outagami, «other-siders»), an Algonkian tribe originally on Lake Superior; driven by the Ojibwa and French south of the Wisconsin River, where their losses forced them about 1760 to unite with the Sacs or Sauks. Hence from early in our acquaintance with them the joint tribe has been known as «Sacs and Foxes,» and they have practically coalesced. They joined the British in the Revolution, and again in the War of 1812; their lands gradually taken away, they moved westward into Iowa, were involved in the Black Hawk war and gave up more land, finally gathered on the Des Moines, and in 1842 were removed to the Osage.

Fox Islands. See ALEUTIAN ISLANDS.

Fox River, a river of Wisconsin, called by the Indians Neenah. It rises in Marquette County, near the centre of the State, and after a course of about 200 miles passes through Lake Winnebago; it enters the head of Green Bay. A canal has been cut from Fox River to the Wisconsin, which is a navigable affluent of the Mississippi, and the channel of the river below Lake Winnebago has been cleared to admit steamboats from Lake Michigan and Green Bay. A grant of land was made by Congress to assist the work.

Fox Shark, or **Sea-fox.** See THRESHER.

Fox-snake, a large harmless snake (*Caluber vulpinus*) of the northern Mississippi valley, light brown in color, marked on the back with small chocolate spots bordered by black, and with a series of smaller spots along the sides and on the yellowish abdomen. It reaches a length of three feet, is irritable and pugnacious, and feeds upon small mammals, especially gophers, mice, and other pests of agriculture.

Fox-sparrow, a large American sparrow (*Passerella iliaca*), notable for its foxy red plumage, and gay song. It is a spring-and-fall migrant in the United States, breeding only north of the Saint Lawrence. See SPARROW.

Fox-squirrel, the largest of the true squirrels (*Sciuriss niger*). These rusty-coated squirrels are denizens of woods. They live in hollow trees or high among the branches, in nests of dry grass, and feed upon fruits, berries, mushrooms, and seeds of various trees. They have been hunted until they have become somewhat scarce in the woods north of Virginia; but southward, they are far more numerous. The flesh is esteemed as food — especially in Florida. Though safe from the depredations of preying birds, because of their size and strength, fox-squirrels are attacked by the foxes and wild-cats, which kill and eat them.

Fox-terrier, a small terrier dog modified from the old-fashioned English white terrier of uncertain origin. It has a dense smooth coat white, with black or black-and-tan markings; and a small black nose; and it generally weighs between 15 and 20 pounds, when in good condition. The fox-terrier has a narrow, tapering face, and small, deep-set eyes, usually gentle, but capable of an expression of keen animation; the jaws are strong and well-shaped; and the V-shaped ears droop forward close to the cheek. The compact little body is set on straight, supple legs, and the tail, usually docked, is carried in a rather jaunty fashion. The dog's appearance is one of alertness; and, though originally bred to run the fox to earth, fox-terriers have, laterly, become popular not only as vermin-destroyers about stables, but as house-dogs,— their cleanly, sprightly, and affectionate ways rendering them extremely amiable and entertaining as companions. One variety, the «wire-haired,» has a rather long coat, of rather shaggy appearance. In all other points this is like the smooth-coated variety. See DOG.

Foxe, John, English martyrologist: b. Boston, Lincolnshire, 1516; d. London April 1587. In 1543 he was elected a fellow of Magdalen College, Oxford. Applying himself to theology with great assiduity, he secretly became a convert to the principles of the Reformation. This tendency being suspected, a charge of heresy followed, and by the judgment of his college he was, in 1545, expelled. In the reign of Mary he went abroad, and gained a livelihood by correcting the press for an eminent printer at Basel, where he laid the first plan of his 'Acts and Monuments of the Church.' On the accession of Elizabeth he returned to his native country, and was received in the most friendly manner by his former pupil, the Duke of Norfolk, who maintained him as long as he lived, and settled a pension on him at his death. Cecil also obtained for him a prebend in the Church of Salisbury. His principal work is the 'History of the Acts and Monuments of the Church' commonly called 'Foxe's Book of Martyrs,' first printed in 1563, in 1 volume folio; reprinted in 1632 and 1641 in 3 volumes folio. In 1684 it had reached the ninth edition.

Foxglove. See DIGITALIS.

Foy, fwä, **Maximilien Sebastien,** French military officer: b. Ham, France, 3 Feb. 1775; d. Paris 28 Nov. 1825. He entered the army at 15, and made his first campaign under Dumouriez in 1792. He received his 15th wound on the field of Waterloo, but refused to quit his post till the close of that engagement. He was afterward employed as inspector-general of infantry; and in 1819 was elected a member of the Chamber of Deputies, where he distinguished himself as an orator, and was a great public favorite.

From his MSS. a ‹History of the Peninsular War› was published by his widow.

Foyle, foil, an Atlantic inlet on the north coast of Ireland, between Londonderry and Donegal. It is 15 miles long, 1 mile wide at its entrance, and 10 miles broad along its south side; but part is dry at low-water and its west side alone is navigable.

Fra Diavolo, frä dē-ä'vō-lō, real name **Michele Pezza**, Neapolitan brigand: b. Itri, Calabria, 1760: d. 1806. He quitted the trade of stocking-weaving for the army, and served for a time in the papal legion. He afterward became a monk, but was expelled on account of misconduct. He then joined a troop of brigands, of which he became in a short time the leader. The government set a price upon his head; but when Cardinal Ruffo undertook to compel the French to evacuate Naples, Fra Diavolo was pardoned, was employed by the cardinal, and received a colonel's commission. At the head of his band he harassed the French, took refuge in Calabria after the conquest of Naples by Bonaparte, and incited the people against the French. He fell into their hands at San Severino in 1806, and was executed as a robber and incendiary. Scribe the dramatist, and Auber the composer, have made the name familiar; but the opera has nothing in common with the real Fra Diavolo except the name.

Fracastorio, Girolamo, jē-rō'lä-mō fräkäs-tō'rē-ō, Italian poet and physician: b. Verona 1483; d. Tacassi 6 Aug. 1553. He was patronized by Cardinal Bembo, to whom he addressed the most celebrated of his works, a Latin poem entitled ‹Syphilis.› In the latter part of his life he wrote a poem on the adventures of the patriarch Joseph, but his poetic fire seems then to have been exhausted, and the virtues of the hero were less happily celebrated than the horrors of the disease. Among the moderns who have exercised their talents in the composition of Latin verse, few have obtained higher reputation than Fracastorio. The elder Scaliger ranks him as a poet next to Virgil, and his merit has been generally acknowledged.

Frackleton, Susan Stuart Goodrich, American artist: b. Milwaukee, Wis., 5 June 1848. She received a private education, and became prominent as a ceramic artist. She has won many prizes in American, European, Canadian, and Mexican competition; invented a gas-kiln for firing decorated china and glass; and was the founder and first president of the National League of Mineral Painters. In 1901 she received a medal at the Paris Exposition for her exhibit of pottery. She published ‹Tried by Fire,› a work on china decoration (1885).

Fraction, a part of any integer (whole number), or unit. For example, "two and a fraction" means two units and that part of a unit which can be distinguished, as one half, two fifths, and so on. In the fraction $\frac{1}{3}$ in arithmetic, or $\frac{a}{b}$ in algebra, the figure 1, or *a*, is the numerator, and 3, or *b*, is the denominator; and they represent that, if a whole number is divided into three or *b* parts, only one or *a* parts are taken. In the addition of fractions, the fractions must be brought down to the same denominator, and their numerators (as expressed in the value of their new denominator) must then be added, when we have one whole fraction. Thus, if we want to add $\frac{1}{3}$ and $\frac{2}{5}$, we must find the least common multiple of 3 and 5, which is found to be 15; then, as 3 goes 5 times into 15, and 5 goes 3 times into the same number, we multiply the numerators of the different fractions by these respective quotients, and then add the two quantities together. Thus, $\frac{1}{3}$ added to $\frac{2}{5}$ will be equal to $\frac{5}{15}+\frac{6}{15}=\frac{11}{15}$. The true definition of a fraction may be thus summed up: It is the division of its numerator by its denominator; as seven eighths are equivalent to the whole number 7 divided by 8 — whence a fraction is obtained. Decimal fractions simplify calculations greatly, as they are constructed on the principle of having one common denominator — a multiple of 10; and thus fractions can be added, subtracted, and divided without repeating over and over the tedious process of bringing them down to a common denominator. See ARITHMETIC; DECIMALS.

Fracture, a break or solution of continuity in a bone, caused by sudden application of violence from without or by sudden muscular strains. Bone diseases and the changes in bone incident to old age predispose to breaks. Compound fractures are those in which a wound allows a communication between the injured bone and the body surface. A fracture is said to be multiple when there is more than one line of cleavage; when the lines of cleavage are joined, the fracture is spoken of as comminuted. Pain in the affected part and more or less loss of function are usually present. Examination reveals a deformity either as a swelling or a deviation from the normal line of the part; palpation elicits exquisite tenderness on direct pressure at the point of injury and on moving the fragments; the bony irregularity may be felt beneath the skin; frequently an abnormal point of mobility may be discovered; crepitus is present as a peculiar grating sensation transmitted to the examining fingers if the ends of the bone can be rubbed together.

Repair of the injury takes place through certain blood-cells organizing the clot of blood and forming a fibrous callus. Later this callus is absorbed and a bony callus formed, the lime-salts being laid down in orderly arrangement by special cells. Nature is assisted in this process by fixation of the fragments in their normal position. This reduction of the deformity requires surgical skill, and all unnecessary manipulation of a bone supposed to be fractured should be avoided. Where removal of the injured from the scene of the accident is necessary, further damage may be prevented by the careful restriction of motion of the part. This can be done by the application of splints or by otherwise securing the part.

Compound fractures are serious because of the great possibility of infection gaining access to the injured bone, with resulting inflammation and necrosis. Measures of fixation are modified to allow of careful aseptic wound-dressing.

The diagnosis of fracture is frequently a matter of great difficulty, so closely may it resemble in its signs a bruise or dislocation. The X-rays render great service in differentiation and study of the kind of break.

Pott's fracture is the name given to a frac-

ture of the lower extremity of the leg-bones, usually accompanied by a turning out of the foot. The ankle-joint is commonly injured and the ligaments ruptured so that more or less permanent disability is usual. Colles' fracture is a break of the lower end of the radius, having generally a characteristic deformity. The upper fragment is jammed down toward the rest and overrides the lower fragment, which is pushed forward. Falls upon the open hand are often apt to cause this injury. Fractures of the patella or kneepan are difficult to treat, owing to the constant pull of the strong muscles on the upper fragment. Entire apposition of the fragments and bony union is rarely possible unless wiring is resorted to. This injury is frequently a result of sudden muscular strain. The upper end of the femur or thigh-bone is frequently fractured in the aged. When the patient is old or feeble the long-continued rest in the recumbent position which is necessary to proper union so lowers the vitality that deformity is frequently accepted through fear of a fatal termination.

Fractures of the skull-bones present some unique features because of the peculiar structure of the bones in two tables, the globe-like arrangement of the skull as a whole, and of the juxtaposition of the easily injured brain. Lines of fracture may travel far from the actual point of injury, and a breaking force may travel to an opposite pole of the skull. The ordinary signs of fracture are absent except the deformity which usually is found as a crack or depression. The element of depression of the fragments is of the greatest importance, usually necessitating the operation of trephining for the relief of cerebral pressure. This operation consists in the removal of the fragments or of the indented area. Hemorrhage from a fracture may cause pressure and necessitate similar relief. Fatal termination is common, particularly where the inaccessible base of the skull is involved.

Fra'denburgh, J. N., American Methodist clergyman: b. Gouverneur, N. Y., 4 March 1843. He was graduated from Genesee College, was professor of mathematics in the Genesee Wesleyan Seminary (1868–9), of ancient languages in the Fredonia Normal School (1869–73), and principal of the Mansfield (Pa.) Normal School (1873–5). After pastorates at Cleveland, Ohio, and elsewhere, he was settled in 1896 at Clarion, Pa. He has published: 'Witnesses from the Dust' (1885); 'Beauty Crowned' (1887); 'Living Religions' (1888); 'Departed Gods' (1891); 'Fire from Strange Altars' (1891); 'Light from Egypt' (1897); 'Life's Springtime' (1900).

Framingham, Mass., a town in Middlesex County, on the Sudbury River, and on the New York, N. H. & H., and the Boston & A. R.R.'s; about 20 miles west of Boston. It comprises the villages of Framingham, South Framingham, and Saxonville. It has a large industry in woolen goods, and an assessed property valuation of nearly $9,000,000. Pop. (1900) 11,302.

Franc, a French silver coin, containing 10 décimes and 100 centimes. Value in American money 20 cents.

Français, François Louis, frän-swä loo-ē frän-sā, French painter: b. Plombières, department of Vosges, 17 Nov. 1814; d. 1897. He was a pupil of Corot and Gigoux at the Beaux Arts, first exhibited at the Salon in 1837, obtained a medal of the first class at the Salon of 1848, and was admitted a member of the Institute in 1890. He became best known as a landscapist, particularly for his views of the Paris environs and glimpses of the Seine. His finest work, 'Daphnis and Chloë,' is in the Luxembourg, together with three other canvases, 'Evening,' 'Orpheus,' and 'The End of Winter.' His style is peculiarly individual in its combination of realism and idealism.

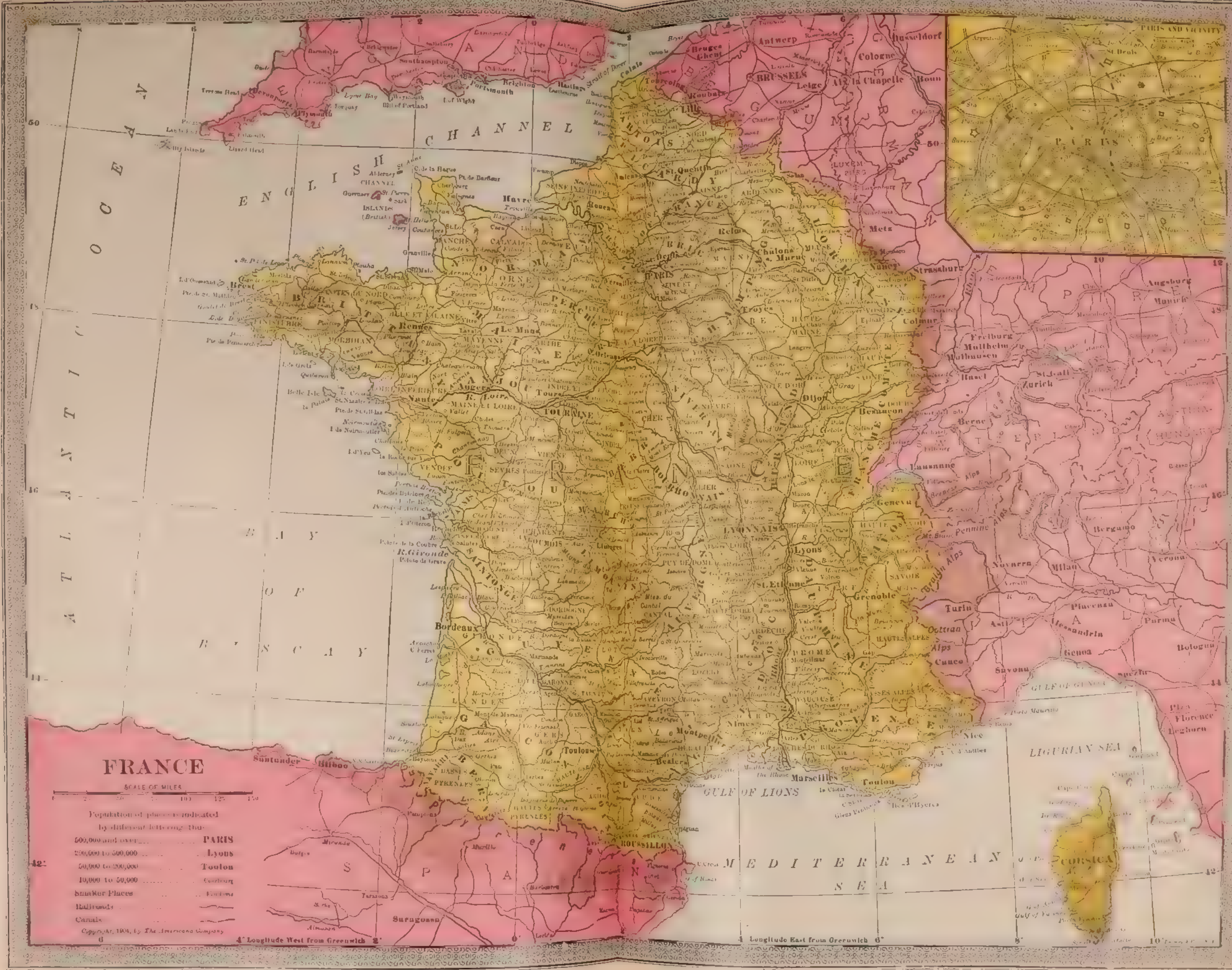
France, fräns, **Anatole.** See THIBAULT, JACQUES ANATOLE.

France, Joseph, French publicist: b. Lorraine 1787; d. 1869. Having entered the French army in 1815, he had become a colonel in 1834, and in 1836–46 was commander of military police in the island of Martinique, West Indies. The publication of his 'La vérité et des faits' (1841), a work descriptive of the ill-treatment of negro slaves in the island, caused his removal from his post and trial for sedition. He was deprived of his commission, but subsequent to the abolition of slavery in the French colonies (1848) was elected from Martinique to the Constituent Assembly, and from 1852 was a member of the council of the island. His publications include: 'Les corsaires français dans les Antilles' (1857); 'Questions coloniales' (1860); 'Statistique de la Martinique' (1861).

France, fräns, **Lewis Browne,** American author: b. Washington, D. C., 8 Aug. 1833. He was educated at Georgetown College, and entered the practice of law in Colorado, of whose supreme court reports he edited volumes III.-XI. His publications include: 'Rod and Line' (1884); 'Mountain Trails and Parks in Colorado' (1886); 'Over the Old Trail' (1894); 'Pine Valley' (1897).

France, in ancient times called Gallia, a maritime country in the west of Europe, since 1870 the largest and most prominent republic in Europe, and the second largest in the world. France is situated between lat. 42° 20' and 51° 5' N.; and lon. 4° 50' W. and 7° 40' E., and is bounded north by the German Ocean and the Straits of Dover; northwest by the English Channel; west by the Atlantic, more especially that part of it called the Bay of Biscay; south by Spain and the Mediterranean Sea; east by Italy, Switzerland, and the German territory of Alsace; northeast by German Lorraine, Luxembourg, and Belgium. The longest lines which can be drawn across France are two diagonals, which intersect each other — the one from the southeast to the northwest extremities, 670 miles, and the other, from the southwest to the northeast extremities, 555 miles. Measured on the meridian of Dunkirk, the greatest length is 600 miles, and measured on the parallel of 48° 20', the greatest breadth is 547 miles. The breadth near the centre is 400 miles, and along the parallel of 46° 15', where it is narrowest, does not exceed 340 miles. The total area of France is 207,054 square miles.

Topography.— While protected by great natural barriers at most parts where it is connected with the continent, a long line of coast on the west and northwest gives it immediate access to the great ocean thoroughfare, while on the



FRANCE
SCALE OF MILES
PARIS
Lyons
Toulon
ENGLISH CHANNEL
ATLANTIC OCEAN
BAY OF BISCAY
GULF OF LIONS
MEDITERRANEAN SEA
LIGURIAN SEA
CORSICA
PARIS AND VICINITY
Antwerp
BRUSSELS
Cologne
Aix la Chapelle
Dusseldorf
Metz
Strassburg
Freiburg
Mulhausen
Basel
Zurich
Berne
Lausanne
Geneva
Turin
Milan
Novarra
Bergamo
Verona
Genoa
Bologna
Parma
Savona
Florence
Leghorn
Nice
Marseilles
Toulon
Toulouse
Bordeaux
Nantes
Rennes
Brest
Havre
Rouen
Reims
Lille
Roubaix
Orleans
Tours
Angers
Le Mans
Dijon
Besancon
Lyons
Grenoble
St. Etienne
Nimes
Montpellier
Beziers
Limoges
Troyes
Nancy
Santander
Bilbao
Saragossa
Southampton
Portsmouth
Brighton
Plymouth
Longitude West from Greenwich
Longitude East from Greenwich

south its harbors in the Mediterranean secure to it a large share in the traffic of that most important of all inland seas. France is traversed from southwest to northeast by several chains of mountains forming the general water-shed of the country. This water shed has two slopes, the one toward the west and north, carrying its waters to the Bay of Biscay, the Atlantic Ocean, the English Channel, and the German Ocean; the other toward the east and south, carrying its waters to the Mediterranean. The ranges of mountains and hills forming this water shed include the western and central Pyrenees, the western Corbières in the department of Aude, the Cevennes, the mountains of Vivarais, Lyonnais, Beaujolais, and Charollais, the Côte d'Or, the Plateau de Langres, the Faucilles Mountains, and the Vosges. This general water shed is met toward the northeast by the eastern mountain ranges of France, namely, the Jura range and various Alpine ranges, one of the peaks of which is Mont Blanc, which may be regarded as the culminating point of the European mountains, although not absolutely the highest mountain in Europe. Near the centre of France, and separate from the great water shed of the country, are several groups of volcanic mountains known by the general name of the Mountains of Auvergne, the chief peaks of which are the Plomb du Cantal in the southernmost group, the Puy de Sancy in the central group, and the Puy de Dôme in the northernmost group. The spurs thrown off by the great water shed divide France into six principal basins, five of which are on the northwestern slope, and one on the southeastern.

Rivers and Lakes.— The great rivers of France are the Seine, Garonne, Lôire, Charente, Adour, Meuse, and the Rhône. In the basin of the Garonne are its affluents, the Ariège, Tarn, Lot, and Dordogne on the right bank, and the Gers on the left bank. To the north of the basin of the Garonne is that of the Loire and its tributaries, the Nièvre and the Maine on the right bank, and the Allier, Loiret, Cher, Indre, Vienne, and Sèvre Nantaise on the left. To this basin also belong the secondary basins of the Vilaine and the Blavet. In the basin of the Seine are its tributaries, the Aude, Marne, and Oise on the right bank, and the Yonne, Loing, Eure, and Rille on the left bank. The secondary basins are that of the Somme in the north, and those of the Orne and Oise in the south. In the basin of the Meuse are its tributaries, the Sambre on its left bank, to which is added the secondary basin of the Escaut or Schelde. The basin of the Rhône occupies the whole of the territory of France which lies to the southeast of the great water-shed. The tributaries of the Rhône are the Ain, the Saône, the Ardèche, and the Gard upon the right bank, and the Isère, Drôme, and Durance on the left. The secondary basins are those of the Var, Argens, and Arc on the east, and those of the Tet, Aude, and Hérault on the west. France has in all more than 212 navigable streams, with a total navigation of 5,700 miles. The lakes are few in number, and individually limited in extent. The largest, Grand-Lieu, in the department of Loire-Inférieure, covers an area of only 27 square miles, and is altogether devoid of interest. The next largest, St. Point, in the Jura, does not cover three square miles. Others of still less dimensions become more interesting from their localities in the lofty regions of the Pyrenees, or in the deep hollows of ancient craters in Auvergne.

Geology.— France possesses all the geological formations in a greater or less degree of development. The mountains generally have a nucleus of granite, which accordingly forms a prevailing rock in the Alps, on the east frontier, and their branches south to the shores of the Mediterranean, in the Pyrenees, the Cevennes, and the elevated plateau of Langres. In the Vosges it is more sparingly developed, its place being often occupied by porphyry; and in the Jura, where limestone occurs in such enormous masses as to have given its name to a peculiar formation. The other crystalline rocks, consisting chiefly of trachytes and basalts, have received a magnificent development in Auvergne, where whole mountains are composed of them, and where the effects of remote volcanic agency are still presented to the eye in extinct craters and lava streams. The granite is overlaid by primitive stratified rocks of gneiss, and of micaceous and argillaceous slates, succeeded, particularly in the Pyrenees, by mountain limestone. The secondary formation, commencing with this limestone and continued in ascending series up to the chalk, always possesses peculiar interest, because within it valuable mines of lead and iron, and all the workable seams of coal, are included. It is largely developed in many parts of France, and furnishes a considerable number of coal and mineral fields. The Tertiary formation, including all the limestones, sands, and clays, above the chalk, occurs continuously in two great divisions, and partially in a number of isolated spots, and covers a vast extent of surface. The larger continuous division is in the southwest, where it commences at the foot of the Pyrenees, and occupies a very large portion of the basins of the Garonne and of the Adour. The lesser but better known division takes the name of the Paris basin, and has been made familiar to the scientific world by the labors of Cuvier and other distinguished naturalists.

Climate.— The climate of France is greatly diversified, and cannot be described accurately without dividing it into different regions. With a very limited exception, it lies wholly within the more moderate portion of the temperate zone. France may be divided into four climatic regions according to the different vegetable products which different districts are able to mature. Within the first, and warmest, the olive is successfully cultivated. It forms the southeast part of France, and is chiefly confined to the departments which border on the Mediterranean. The second region is characterized by the general cultivation of maize or Indian corn. The third region reaches north to the extreme limit of the profitable culture of the vine, and may be considered as determined by a line stretching between the mouth of the Loire and the town of Mézières, in the department of Ardennes. All the country beyond this line is included in the fourth region. In the northwest the prevalence of winds from that direction often produces a superfluity of moisture, which manifests itself in mists or in frequent and heavy showers of rain. At the opposite extremity, the southeast, a contrary effect is produced, and a sultry, stifling wind wrinkles up

the skin, and not unfrequently spreads fever in its most malignant form. But it is only to a few exceptional districts that these remarks apply. After allowing for them, more than four fifths of the surface remains, under an atmosphere remarkable, more especially in its central districts, for salubrity, serenity, and brightness.

Political Divisions.— Before the revolution of 1789 France was divided into general governments, the number of which has varied at different epochs. Under Francis I., by whom they were instituted, there were 9. Under Henry III. there were 12. Under Louis XIV. the number was fixed at 32, to which a 33d was added by the acquisition of Corsica, under Louis XV. In 1789, when the love of change became paramount, the provinces were not permitted to escape; and it was then determined that the whole of France, including the island of Corsica, should be parceled out into departments, and each department subdivided successively into arrondissements, cantons, and communes, an arrangement which was actually carried out in 1790. This division has since maintained its ground, each department being named after the most important physical feature which it contains. The number of departments was originally 83, but it has been at different times increased and decreased. There are now 87 departments, the last formed being Haut-Rhin (Belfort). As the old provinces, though no longer recognized in legal and other formal documents, continue so familiar to the French themselves, and are so frequently mentioned, not only by earlier writers, but in the geographical, historical, and statistical works of the present day, a table is here given exhibiting these provinces in alphabetical order, and in parallel columns, the chief town in each, and the departments most nearly corresponding to them:

Provinces	Departments	Capitals of Provinces
Alsace	(Now German, except Belfort, or dep. Haut-Rhin)	Strasbourg (German)
Anjou	Maine-et-Loire	Angers
Artois	Inland or southeastern portion of Pas-de-Calais	Arras
Aunis	Maritime part of Charente-Inférieure	LaRochelle
Auvergne	Puy-de-Dôme and Cantal	Clermont
Béarn-et-Navarre	Basses-Pyrénées	Pau
Berry	Cher, Indre	Bourges
Bourbonnais	Allier	Moulins
Bourgogne	Ain, Côte-d'Or, Saône-et-Loire, Yonne	Dijon
Bretagne	Côtes - du - Nord, Finistère, Ille-et-Vilaine, Loire-Inférieure, Morbihan	Rennes
Champagne	Ardennes, Aube, Marne, Haute-Marne	Troyes
Corsica	Corse	Ajaccio
Dauphiné	Hautes-Alpes, Drôme, Isère	Grenoble
Flandre	Nord	Lille
Foix	Ariège	Foix
Franche Comté	Doubs, Jura, Haute-Saône	Besançon
Gascogne-et-Guyenne	Aveyron, Dordogne, Gers, Gironde, Lot, Lot-et-Garonne, Landes, Hautes-Pyrénées, Tarn - et - Garonne	Bordeaux
Ile de France	Oise, Seine, Seine-et-Oise, Seine-et-Marne, southern part of Aisne	Paris
Languedoc	Ardèche, Aude, Gard, Hérault, Haute - Garonne, Haute-Loire, Lozère, Tarn	Toulouse
Limousin	Corrèze, Haute-Vienne	Limoges
Lorraine	Meuse, Vosges, Meurthe-et-Moselle (and German Lorraine)	Nancy
Lyonnais	Loire, Rhône	Lyon
Maine	Mayenne, Sarthe	Le Mans
Marche	Creuse	Guéret
Nivernais	Nièvre	Nevers
Normandie	Calvados, Eure, Manche, Orne, Seine-Inférieure	Rouen
Orléanais	Eure-et-Loire, Loiret, Loir-et-Cher	Orléans
Picardie	Somme, maritime part of Pas-de-Calais, N. part of Aisne	Amiens
Poitou	Deux - Sèvres, Vendée, Vienne	Poitiers
Provence	Basses-Alpes, Bouches-du-Rhône, Var, eastern part of Vaucluse	Aix
Roussillon	Pyrénées-Orientales	Perpignan
Saintonge and Angoumois	Charente and eastern or inland part of Charente-Inf.	Angoulême
Touraine	Indre-et-Loire	Tours

The following territories have been acquired since 1790:

Territories	Departments
Avignon and Venaissin (including Orange previously acquired)	Part of Vaucluse
Nice	Alpes-Maritimes
Savoie	Savoie, Haute-Savoie

Agriculture.— About nine tenths of the soil of France is productive, and about one half of the whole French territory is under the plough. In regard to the management of arable land, the French are still far behind the English, but have nevertheless made great advances during the 19th century. During the last 50 years the production of cereals in France has increased by nearly 70 per cent, while the extent of land under cereals increased by only one quarter. This is equivalent to saying that the productiveness of the soil has increased in that time by fully one third. The cereals forming the great bulk of the cultivated crops are wheat, oats, rye, and barley. The crops next in importance to these are meslin or mixed corn, potatoes, hemp, rape, maize, buckwheat, flax, and beet. This last plant is cultivated extensively in some departments, especially in that of Nord, for the manufacture of sugar. The most valuable crops of which the cultivation on a great scale is not general, but confined to particular districts, are madder, tobacco, saffron, and hops. The cultivation of tobacco is monopolized by the government, and is confined to certain departments. It yields an annual gross revenue to the government of about $75,000,000, but from this total there falls to be deducted the expense incurred in the cultivation and manufacture of the tobacco. In France the grass is on a much more limited scale than the arable husbandry, the land in permanent meadow being in extent only one sixth of that under the plough. The breeding of stock, notwithstanding the stimulus afforded by the establishment of numerous societies, general and local, for its encouragement, is, in France, if not imperfectly understood, very indifferently practised. The races of oxen, instead of being confined to a few of the more perfect types, are almost as various as the different districts into which the country is divided, and include a few good breeds, particularly in the rich plains of Lower Normandy. The rearing of sheep is more successful, and much wool, scarcely inferior to that of the merino, is raised. The general employment of cattle for agricultural purposes gives little encouragement to the rearing of draft horses; but the warlike propensities of the nation have always created an extensive demand for horses. Asses and mules, generally of a superior de-

scription, are much used in France. The cultivation of the vine is one of the most important branches of French agriculture. The total quantity of land in vineyards is nearly a twenty-fifth of the whole surface; but as there are extensive and continuous districts where there are no vineyards, the proportion which vine-land on the districts properly adapted to it bears to the whole land under cultivation, attains a much higher ratio. The various first-class wines, under the name of Champagne, Burgundy, Bordeaux, etc., are in high repute and general demand over all Europe. In 1901 France produced 1,784,854,500 gallons of wine. A large part of the wealth of France consists in its fruits. Among the most important fruit-trees are the apple, the fruit of which, in the northern districts, particularly in Normandy, is largely used for the manufacture of cider; the chestnut, which, in barren districts yields an article of food which takes the place of the cereals among the poorer classes; the mulberry-tree, cultivated in 8 or 10 departments in the southeast, both for its fruit and its leaves, the leaves being used as food for the silkworms, on which the French silk manufacture depends; the olive, which grows in the same districts as the mulberry; the pear, plum, cherry, apricot, peach, orange, citron, fig, almond, etc. The forests of France occupy about one seventh part of the whole territory. Their principal localities are the Ardennes, Vosges, and Plateau de Langres, in the northeast; the Jura in the east; and the mountains of Auvergne in the centre. The chief constituents of French forests are the oak, the elm, the pine, the fir, the larch, the birch, the beech.

Mineral Resources.— The coal-fields of France are so numerous that coal-pits exist in no fewer than 33 departments; but most of these are very limited in extent. Several of the smaller fields occur in the northwest, and also in the south, where both anthracite and lignite are found; but the fields whose importance entitle them to particular notice are only two — that of Valenciennes in the northeast, forming the western extremity of the great Belgian coal-field, and that of St. Etienne, to which the manufactures of that town, Lyons, and the surrounding districts, are indebted for much of their prosperity. The annual output is over 30,000,000 tons, but falls so far short of the annual consumption that a large import takes place from England and Belgium, and wood continues to be the common fuel throughout France, at least for domestic purposes. The coal-fields contain seams of iron, which are extensively worked, and furnish ore to a great number of blast-furnaces. Though the number of mines actually worked is great, the quantity of foundry pig annually produced is only about 2,500,000 tons. Few countries have been said to be so rich in lead as France. It occurs in greater or less quantity in a great number of districts, and is generally argentiferous. Manganese is very widely diffused, but is worked only in a few mines. Gold exists both in the sands of rivers and *in situ* in thin streaks embedded in quartz. Attempts have been made to work it, but not with success. A vein of quicksilver was opened about the middle of the 18th century, and was worked successfully for 12 years, and then abandoned. Zinc, copper, arsenic, nickel, and cobalt exist, but not in such quantities as to be workable to profit. The principal saline substances are alum and common salt. The great sources from which salt is derived are the lagoons and salt marshes which line many parts of the coast. Of these the produce is about 300,000 tons. A large revenue is also derived from quarries, and valuable beds of common clay, fine potter's earth, and kaolin.

Manufactures.— The most important manufacture is silk, which, in a great variety of forms, plain and figured, has its principal locality at Lyons and the towns of the surrounding districts. The value of the silk manufactured annually is about $100,000,000. After it follow cotton stuffs, pure and mixed, at Amiens, Rouen, St. Quentin, Troyes, Lille, etc.; woolens, including broadcloths, at Louviers, Elbeuf, Sedan, etc.; lighter woolen stuffs at Roubaix, Tourcoing, Lille, and Rheims; carpets at Paris, Aubusson, Felletin, and Abbeville; and tapestry at Paris and Beauvais; linens, including fine muslin, gauze, and lace, at Valenciennes, Courtray, St. Quentin, Alençon, Caen, etc.; porcelain at Sèvres, Paris, Limoges, and Bayeux; stoneware at Nevers, Montereau, etc.; and common pottery at Paris, Nevers, and elsewhere; beet-root sugar, chiefly in the department of Nord; leather, and the various articles made of it, including gloves; paper, plain and stained; hats, hosiery, steel, iron, brass, and zinc ware, plate and flint glass, etc. Besides these, a great number of articles in which skill, taste, and ingenuity are more especially required, have their common seat in the capital. Among others may be mentioned jewelry, clocks, surgical and mathematical instruments, carriages, works in ivory, printing type, and engravings.

Commerce and Shipping.— The commerce is usually divided into internal and external. The former is unquestionably the larger of the two. In 1902 the imports for home consumption amounted to $883,140,000; the exports of native products and manufactures amounted in 1902 to $847,400,000. The general commerce, including *all* goods entering or leaving France in 1901, was: Imports, $1,121,240,000; exports, $1,043,940,000. The foreign commerce is chiefly with Great Britain, Belgium, Germany, the United States and Italy. Great Britain is far ahead of the others; its imports from France consist chiefly of butter, eggs, grain, silks, wine and brandy, woolens and sugar.

In the year 1901 the merchant navy of France included 15,692 vessels of two tons and upward, with a total tonnage of 1,110,988 tons; and the number of steamers alone was 1,299 of 546,541 tons. The canals are numerous, and furnish signal displays of engineering skill. The Canal du Midi, or, as it is sometimes called, the Canal of Languedoc, starting from a point in the Garonne a little below Toulouse, is continued into the lagoon of Thau, and thereby gives a continuous navigable communication between the Atlantic and the Mediterranean, in the line of the important towns of Bordeaux, Agen, Toulouse, Carcassonne, and Narbonne. In like manner three separate canals cut across the basin of the Rhône: the Canal du Centre, or of Charollais, which commences at Châlons-sur-Saône, and proceeds to Digoin, on the Loire; the Rhône and Rhine Canal, so called from uniting these two rivers, partly by the intervention of the Doubs; and the Canal of Bourgogne,

which, proceeding also from the Saône, communicates with the Yonne, and through it with the Seine. The effect of these three canals is to break down the barriers which isolate the basins of the Rhône, Loire, Seine, and Rhine, and give navigable access from any one of them into the other three. The railways in France partly belong to the state, and partly have been granted to private companies for a limited period, at the end of which they become state property. There are also certain local lines which at the end of a fixed period come into the possession of the departments. In 1900 there were in France 29,125 miles of railway in operation, of which 1,870 miles were described as government lines. In 1901 the total number of letters, book-packets, etc., that passed through the French postoffice was 2,579,797,000. The total length of telegraph lines in France in 1901 was 87,382 miles, and of wires 328,700 miles. The total number of inland messages is about 37,000,000; of international messages about 6,000,000. According to the budget of 1900 the total gross revenue derived from the postoffice service in that year was $54,178,112, including telegraphs and telephones, showing a net working profit of $13,741,921.

Administration of Justice.— In accordance with the general arrangement which divides the whole country into departments, each department into arrondissements, each arrondissement into cantons, and each canton into communes, there is a series of courts, commencing with the lowest of these divisions, and rising above each other in regular order. First, each commune has a justice of peace, who judges in petty causes, but whose more appropriate function is understood to be to act as a kind of umpire between parties at variance, and induce them to settle their differences without proceeding to formal litigation. If the attempt at conciliation fails, the complainant brings his action before a court which, from being that in which the action must originate, receives the name of court of primary or first jurisdiction. Every arrondissement has such a court, and has, moreover, if any more important trading town is situated within it, a *tribunal de commerce*, to which mercantile and commercial causes are appropriated. It has also, occasionally, a court called *conseil de prud'hommes*, in which persons of skill and character, not vested with ordinary legal functions, settle disputes on principles of equity, and pretty much in the character of arbitrators. From these courts of primary resort an appeal lies to a number of courts called *cours d'appel*. They are in all 27, and have each jurisdiction over several departments. These courts generally hold their sittings in the most important town situated within their jurisdiction. The *tribunaux de commerce* in the most important commercial and manufacturing towns consist of members who are elected by the chief business men of the respective places. Above all these courts, and properly the only supreme court of the state, is the *conseil supérieur* or *cour de cassation*, so called from its power of reviewing and annulling the decrees of inferior courts.

Education.— In France education in all its branches has long been taken under the special cognizance of the state, and the superintendence of it is expressly committed to a high functionary, who takes the name of minister of public instruction. The principal educational establishments are classed under three heads — primary, secondary, and superior. At the head stands the university, which is very different from other universities, and embraces the *facultés* or university colleges scattered over the whole of France in the principal towns. These are also connected with the different *académies* or educational centres, of which there are 16 in France, each comprising so many of the departments. At the institutions known as *facultés*, the education given, as in the best modern universities, is of the highest description. Secondary education is given chiefly in the *lycées* or lyceums and in the *collèges*, there being institutions of both kinds for girls as well as for boys. Primary instruction is intended for the whole population, attendance at the primary schools being compulsory and the education free. The public schools are now all under the charge of laymen. There are still numerous private schools and institutions, however, many of which are managed by the clergy and religious bodies, but in all cases children have to undergo a public examination. Religion, in like manner, is taken under the cognizance of the state, and falls within the province of a special minister. The state places all forms of religion on an equal footing, and professes to deal impartially with all by paying salaries to their ministers. With the quality of the particular religion, therefore, the state concerns itself no further than simply to know that it is not obviously subversive of social order or good morals. The Roman Catholics form about 78½ per cent of the total population, the Protestants less than 2; many profess no religion. See ROMAN CATHOLIC CHURCH.

Army and Navy.— By the law of 1892, personal military service is declared to be obligatory. Every Frenchman 20 years old and not unfit for military service, must serve, first in the regular army for 3 years, then in the reserve of the regular army for 10 years, next in the territorial army for 6 years, and finally in the reserve of the territorial army for 6 years. By the law referring to the organization of the army, the territory of France is divided into 18 regions, each of which is again subdivided. Each region is occupied by a *corps d'armée*, and there is also a corps d'armée assigned to Algeria. Each region has general stores, and each subdivision has one or more special stores supplied from the general ones. Each corps d'armée comprises two divisions of infantry, one brigade of cavalry, one brigade of artillery, one company of engineers, one rifle battalion, field-batteries, bridge train, etc. The active army and its reserves are distributed all over France, but the territorial army and its reserves are confined to fixed areas. In 1902 the total strength of the regular army on a peace footing amounted to 616,092 men, of whom 380,881 were infantry, 76,131 cavalry, 81,527 artillery, 13,426 engineers, 20,700 staff and administration, 11,418 military train, and 22,861 gendarmerie.

In 1901 the French navy was possessed of 20 first-class battleships, 11 second-class, and 14 third-class; 14 port-defense ships; 51 first, second, and third class cruisers; 250 torpedo boats, and 35 torpedo gunboats; and 34 submarines. These numbers include ships in course of building, but exclude transports and non-service ves-

sels. The navy is manned partly by conscription and partly by voluntary enlistment. There are 25,000 men serving with the fleet with a reserve of 114,000 men.

Revenue and Debt.— France has now a larger revenue, expenditure, and public debt than any other country in the world. The revenue for 1902 was $720,493,094, expenditures, $720,466,649. The total national debt and interest in 1902 was $6,307,000,000.

Government.— France has been a republic since the overthrow of the second empire by a Paris mob on 4 Sept. 1870. The details of the constitution were fixed by a law dated 25 Feb. 1875, and several amendments have been enacted in subsequent years. This law places the legislative authority in the hands of a National Assembly composed of two chambers, the chamber of deputies and the senate. The chamber of deputies consists of 584 members representing the arrondissements, and the members are elected for four years by universal suffrage. The senate consists of 300 members, who must be 40 years of age at least. They are elected by special bodies of delegates for nine years, one third retiring every three years. The head of the government is a president, elected for seven years by a majority of votes of the members of the two chambers sitting as one National Assembly. No one can be a member of this body who has not undergone the legal military training.

Weights, Measures, and Money.— An account of the present system of weights, measures, and moneys in France is contained in the article METRIC SYSTEM.

Areas and Population.— In addition to its European territory, France possesses extensive tracts in Asia and Africa, with smaller possessions in America and Oceania. These, with their area and population in 1901, are exhibited in the following table:

COUNTRIES	Area in sq. miles	Population.
FRANCE	207,054	38,961,945
IN AFRICA —		
Algeria	184,474	4,739,300
Tunis	51,000	1,900,000
Western Sahara	1,544,000	2,550,000
Senegal	80,000	1,800,000
Senegambia and Niger	210,000	3,000,000
French Guinea	95,000	2,200,000
Ivory Coast	116,000	2,000,000
Dahomey	60,000	1,000,000
Congo	1,160,000	10,000,000
Somali Coast and Dependencies	45,000	200,000
Réunion	966	173,200
Comoro Isles	620	47,000
Mayotte	140	11,640
Madagascar and Islands	227,950	2,505,240
IN ASIA —		
India	196	273,000
Anam	52,100	6,124,000
Cambodia	37,400	1,500,000
Cochin-China	22,000	2,968,600
Tonquin and Laos	144,400	7,641,900
IN AMERICA —		
Guiana	30,500	32,910
Guadeloupe and dependencies	688	182,110
Martinique	380	203,780
St. Pierre and Miquelon	92	6,250
IN OCEANIA —		
New Caledonia and dependencies	7,650	51,410
Establishments in Oceania	1,520	29,000
Total	4,279,130	90,101,285

The principal cities and towns of France, with their population for the year 1901, are as follows: Paris, 2,714,068; Marseilles, 491,161; Lyons, 459,099; Bordeaux, 257,638; Lille, 210,696; Toulouse, 149,841; Rouen, 116,316; Rheims, 108,385; Nice, 105,109.

History.— France or Gaul, at the earliest known period was inhabited by 300 or 400 independent tribes, divided into three great families, the Celts or Gauls, the Iberians or Vasconians, and the Belgæ. The Iberians appear to have been the earliest settlers, and to have entered the country by way of Africa and Spain. Before the arrival of the Celts it is probable that the Iberian tribes had spread a considerable distance northward into the heart of France, but they were gradually driven southward by the new settlers, until at the time of Julius Cæsar they occupied, under the name of Aquitanians, only the southwestern portion of Gaul lying between the Pyrenees and the river Garonne. About 600 B.C. a body of Phocæans founded the most celebrated of the Greek colonies in all Gaul, to which they gave the name of Massilia, now Marseilles. When Rome grew in power the Greeks of Massilia, animated by jealousy and fear of Carthage, became the allies of the Romans, and it was in aid of these allies, against whom the neighboring tribes of Gaul had risen, that the first Roman expedition was sent into Gaul beyond the Alps. This was in 154 B.C., when the Romans, after subduing the insurrectionary tribes, handed over their territory to the Massilians. When the Romans were again called in to aid their Greek allies in Gaul (125 B.C.) the territory which they subjugated was retained by them, and erected into a Roman province. The first Roman settlement was Aquæ Sextiæ (now Aix), which was founded in 122 B.C., and their power was to some extent secured by the foundation, in a favorable situation, of the colony of Narbo Marcius (Narbonne), 118 B.C. This Roman territory in the southeast of Gaul was long known simply as Provincia, whence the modern Provence. Not long after coming into the possession of the Romans this province was in danger of being wrested from them by vast hordes of Cimbri and Teutones who came from the eastern side of the Rhine and inundated Gaul. Having reached the banks of the Rhône they routed five Roman armies in succession, and had they then crossed the Alps might have imperiled the safety of Rome itself. Fortunately, however, they turned their course to the Pyrenees, and before they returned Marius was ready with another army to defend the Roman province. A battle took place at Aix in 102 B.C., in which the barbarian hordes were totally defeated, and another detachment who had made their way into northern Italy met with the same fate in the year following. From that year till 58 B.C., when Cæsar obtained the Roman province in Gaul as his proconsular province, there was comparatively little change in Gaul; but no sooner did Cæsar appear than one pretext after another was found for gradually subduing the whole of Gaul. The conquest was completed between the years 58 and 51 B.C. (Cæsar's authority in Gaul having previously been renewed for another term of five years). Under Augustus the whole territory was divided into 60 municipal districts, each of which was administered by a Roman colonial city, or *municipium*. The chief seat of the government of the whole of Gaul was the colony of Lugdunum. This administrative division of Gaul un-

der the Romans subsisted till the 4th century. In 365 A.D. another important change was made in the administration of Gaul by the institution, by Valentinian I., in all the municipia, of tribunes, a class of officers who were designed to guard the interests of the municipia against any encroachments on the part of the imperial officers. Greater changes, however, had begun to make themselves manifest. The Roman empire was in its decline, and the constant revolutions and civil wars in the heart of the empire emboldened some of the Gaulish people to make attempts to recover their independence. The Romans thus found it difficult at times to maintain their power in Gaul, and the weakness of the empire was also felt by the German tribes bordering on Gaul, who eventually overthrew the Roman legions and established themselves in Roman territory. The most important of the settlers were the members of one of two confederacies of German tribes which had formed themselves on the right bank of the Rhine in the first half of the 3d century. Scarcely had the country begun to settle down under the new arrangements when it was invaded by the Huns, a nation of horsemen who had come from central Asia, and who are described as hideous in appearance and savage in disposition. After destroying the Burgundian kingdom on the east side of the Rhine, they penetrated into Gaul, but were met by the Roman general Aëtius, at the head of an army composed partly of Roman legions and partly of contingents from the Visigoths, Franks, etc., and, after prodigious carnage, were defeated (451 A.D.) in a battle fought on the Catalaunian Plains and compelled to leave the invaded territory. Among the most prominent allies of the Romans in that sanguinary battle were the Salian Franks, under their leader Merovæus. Thirty-five years later they were turned from allies to enemies, and attacked and defeated the Romans, which was the first step in conquering the whole of Gaul and founding a new kingdom, France, which derived its name from the conquerors. The Salian Franks were by no means a powerful tribe. They occupied only a few districts of what is now Belgium, and could scarcely muster more than 5,000 men capable of bearing arms. Their chief or leader, Clovis, proposed to his followers an expedition into the Roman territory, and induced the king of Cambrai to support him in his enterprise. The expedition was actually undertaken, and in the battle which ensued, near Soissons (486 A.D.), the Roman governor, Syagrius, was defeated, and compelled to take refuge among the Visigoths. He was afterward delivered up to Clovis, and put to death. Clovis was now master of all the Roman territory in Gaul except the towns, the inhabitants of which, urged on by the bishops, refused to submit to the conqueror. But what he could not at once effect by force of arms was effected peacefully by his marriage with Clotilda, a Christian and a Roman Catholic, the niece of Gundebald, king of Burgundy. The bishops, hoping that Clovis himself would soon be converted, immediately opened their gates to him. The adoption of the Christian faith by Clovis followed three years after.

Whatever may have been the motives which induced Clovis to take this step, it was undoubtedly the wisest thing that he could have done. It at once secured him the favor and support of all the Gallo-Roman bishops, not only in the formerly Roman territory, but also in that of the Burgundians and Visigoths. During a career of conquest, treachery, and cruelty he added to his dominions all the territory on the north as far as the Rhine, and became the sole Frankish king, the founder of the dynasty which reigned till 752, and which obtained the name of Merovingian, from his grandfather, Merovæus. He died in 511, leaving his kingdom to be divided among his four sons.

The spirit of conquest which was so powerful in Clovis still lived in his sons, and under them the Franks, though divided, succeeded in enlarging their empire still further. Thuringia was conquered (530), Burgundy reduced from a tributary to a subject state (534), and the Alemanni of Suabia fully incorporated in the Frankish empire. Under Clotaire I., the last surviving son of Clovis, the dominions of the Franks, thus extended, were in 558 united under one ruler for the first time since the death of Clovis. Clotaire I. lived till 561, when the dominions of the Franks were again divided. The next unification took place under Clotaire II., who reigned as sole king from 613 till 622, when he appointed his son, Dagobert, king of Austrasia. On the death of Clotaire II. in 628, Dagobert succeeded him as sole king, and his reign saw, in the first place, the Frankish power raised to the greatest height which it reached under the Merovingians, but saw also the beginning of its decline. During the most prosperous part of his reign his dominions extended from the Weser to the Pyrenees, and from the Atlantic Ocean to the frontiers of Bohemia. He was the ally of the emperors of Constantinople; he interfered in the affairs of the Visigoths of Spain, and in those of the Lombards of Italy. In short, he might be regarded as the head of all the barbarian tribes which then occupied the provinces that had formerly constituted the Roman empire in the west. But even during his lifetime the hold of the Franks on some of the more remote parts of their dominions began to be loosened, and after his death in 638 the states which broke away from their allegiance became more numerous. The kingdom was then once more divided, one of his two sons receiving Neustria, and the other Austrasia. Early in the 7th century war broke out between the two kingdoms. A battle was fought at Testry, near Péronne, in 687, in which Roman France, as Neustria had now come to be called, was vanquished by Teutonic France, and the authority of Pépin d'Héristal rendered supreme throughout the kingdom. This date may be regarded as that of the real termination of the Merovingian line. Pépin died in 714 and was succeeded, after a brief period of anarchy, by his son Charles Martel, or Charles the Hammer — a title he earned by the courage and strength he displayed in battle. During his tenure of power all Europe was threatened by the Saracens, who, after traversing the north of Africa, had crossed over into Spain and occupied it, then penetrated into France and seized Aquitaine, at that time ruled over by a member of the Merovingian race holding the title of duke. He appealed for assistance to Charles Martel, who met the Saracen hosts on a plain between Tours and Poitiers, where in 732 he totally defeated them in a battle which, on account of its carnage and the decisive nature of

its results, calls to mind that fought against the Huns on the Catalaunian plains. The Saracens were at once driven from every part of France except Septimania, which they had taken from the Visigoths, who had continued to hold it ever since the overthrow of their kingdom by Clovis. Another consequence of this battle was that the Duke of Aquitaine took an oath of allegiance to Charles Martel. Pépin le Bref, the son of Charles Martel, was the first of his family who was recognized as king of the Franks. He succeeded his father in the possession of Neustria in 741, while Austrasia fell to his brother, Carloman, who died in 747. In 752 Pépin was crowned and anointed king of the Franks by Boniface, archbishop of Mayence. Childéric, the last of the Merovingians, was confined in a monastery. The reign of Pépin was one of almost continuous war and conquest. In Italy he defeated the Lombards, and gave their territory to the popes; in France he wrested Septimania from the Saracens (752–759), and subjugated Aquitaine (759–768). In 768 he died, and was succeeded by his son Charles, afterward known as Charlemagne, and Carloman. The latter dying in 771, Charlemagne then became sole ruler, and he conquered and organized an empire which extended from the Atlantic on the west to the Elbe, the Saale, and the Bohemian mountains on the east, and embraced also three fourths of Italy, and Spain as far as the Ebro. By Pope Leo III. on Christmas Day, in the year 800, he was crowned in the name of the Roman people as emperor of the West. His power was respected by the emperors of Constantinople, and his fame extended so far that even Harun-al-Rashid, the caliph of Bagdad, sent him valuable presents from the far East. He died in 814.

After his death, or at least after the death of his son, Louis I., in 840, the history of the Carlovingians bears a close resemblance to that of the Merovingians, until in 987 it reaches a similar termination. The latter part of the reign of Louis was disturbed by the quarrels of his sons, whom he had now associated in the government with himself, but who were unable to agree as to the share of the empire which should fall to each. After the death of Louis they took up arms against each other, and it was not till after the hard-contested battle of Fontenailles in 841 that peace was brought about and the brothers agreed to the partition of the empire proposed in the Treaty of Verdun (843). From this time the tribes in the east began gradually to fuse together into one nation, and the separation between France and Germany became proportionally more and more distinct. They had not yet, however, been united for the last time under one rule. After Charles the Bald had been succeeded in 877 by Louis II., and Louis II. by Louis III. (879–882) and Carloman (879–884), the whole of the dominions of Charlemagne came under the sway of Charles the Fat, who remained sole ruler of the empire till 887, when he was deposed. From that date the political history of France is distinct from that of Germany.

The royal power in France was then usurped for a time by Eudes, count of Paris, but in 893 Charles III. (the Simple), the brother of Louis III., was recognized as king. His kingship, however, was merely nominal. France had in effect become covered with a multitude of petty kingdoms, the rulers of which bore the titles of dukes and counts. Thus the Duke of Gascony possessed nearly all the district to the south of the Garonne; the counts of Toulouse, Auvergne, Périgord, Poitou, and Berry, the provinces between the Garonne and the Loire; and the regions to the north and east of the latter river belonged to the count of Forez, the Duke of Burgundy, the Duke of France, and the counts of Flanders and Bretagne. The entire possessions of the king consisted of a few towns that he had not as yet been compelled to give away. In the midst of these powerful nobles Charles found himself almost impotent, and was quite unable to offer any adequate resistance to the Norman pirates who had long ruled the seas and devastated the coasts of England, France, and other countries, and who now made more frequent and more destructive incursions into French territory. Charles, accordingly, adopted the wisest policy that he could have followed in the circumstances — surrendering to them in 912 the province which took from them the name of Normandy in order that they might settle there peacefully and cease to lay waste the country by their ravages. Toward the end of his reign Charles found himself so weak as to be unable to resist his own nobles, who in 922 elected one of their number, Robert, Duke of France, king, in opposition to him, and upon the death of Robert in 923 conferred the same dignity upon Rudolph, Duke of Burgundy. During this period Hugh of Paris, as he is generally called, Duke of France, was really the most powerful person in the kingdom, and held King Charles in close captivity. Charles died in 929, when there reigned in succession till 987 the son, grandson, and great-grandson of Charles — Louis IV. (D'Outremer), from 936–954; Lothaire, from 954–986; and Louis V., from 986–987. During these three reigns the real power, such as it was, was held by Hugh of Paris till his death in 956, and then by his son Hugh Capet. On the death of Louis V. without children in 987 Hugh Capet mounted the throne himself, and thus became the founder of the Capetian dynasty.

Hugh Capet died in 996, and his first three successors, Robert (died 1031), Henry I. (died 1060), and Philip I. (died 1106), effected nothing whatever toward the establishment of the royal authority. When Philip I. died he was succeeded by Louis VI. Louis was a complete contrast to Philip, resolute in his endeavors to make his power felt throughout his kingdom, and active in the field, compelling his refractory nobles to yield submission.

Louis VI. died in 1137, and was succeeded by his son Louis VII., who reigned till 1180. Louis VII. was not, like his father, an active soldier, but he followed the same policy. During his reign the stability of the French throne was endangered by the great influence acquired in France by Henry II. of England, who possessed either by inheritance or by marriage the whole of the west of France except Brittany, and obtained some influence even in that province by the marriage of one of his sons with the only daughter of the count. Fortunately for France, Henry, through domestic embarrassments, was unable to pursue any schemes of conquest which he might have cherished against his feudal superior in France. Louis was succeeded by his son Philip Augustus (Philip II.),

who saved the throne of France from the danger with which it was threatened by the great ascendency which the king of England had acquired among the vassals of the king of France. Having summoned the weak King John to appear before the court of peers to answer for his conduct in the case of Prince Arthur, he at once proceeded, when John refused to appear, to execute the sentence by seizing Normandy, Maine, and Anjou. His son, Louis VIII., who succeeded him in 1223, carried on the work by the conquest of Poitou. The unity of France more firmly consolidated in a peaceful way by the wisdom and justice of Louis IX. (St. Louis), whose Establishments, belonging to the close of his reign, may be regarded as having put a formal seal upon this re-established unity, for these formed the first legislative enactments of the house of Capet, the first instance of general legislation for the kingdom of France for nearly 400 years, the last Capitulary or general law having been promulgated in the reign of Charles the Simple.

Louis IX. died in 1270, and from this date, under Philip (III.) the Bold (died 1285), Philip (IV.) the Fair (died 1314), Louis X. (died 1316), John I. (died 1316, after a reign of five days), Philip V. (died 1322), and Charles IV. (died 1328), the Crown continued steadily to increase in power by the acquisition of fresh domains and other means until the outbreak of the wars with England. In the reign of Philip III. a blow was given to the declining power of the nobles by the institution of letters of nobility conferring the rank of nobles upon commoners. Still more important was the recognition by Philip IV. of the bourgeoisie, the new class of society that had grown up in the communes, by calling their representatives as deputies of the cities to form one of the three orders of the States-General. The other two orders consisted of the clergy and the nobility. No small accession of strength to the crown was gained also by the suppression of the order of Knights Templars and the confiscation of their vast possessions, as also by the election of a French pope, who resided at Avignon under the influence of the French monarch.

The first branch of the Capetian line of kings became extinct on the death of Charles IV., the last of the sons of Philip the Fair, for what is called the Salic law (from the fact of its being the rule of succession to fiefs among the Salian Franks), which excluded women from the throne, had become the rule of succession in the case of the crown of France. The right of succession thus reverted to Philip of Valois, son of Robert of Valois, and grandson of Philip the Bold, who actually obtained the crown as Philip VI. His claim was disputed by Edward III. of England, who asserted his own right to the kingdom, on the ground that although the Salic law excluded women from the throne, it did not prevent a woman from transmitting the right of succession to her descendants, and that therefore he was the rightful heir as the son of Isabella, daughter of Philip the Fair. The claim thus set up by Edward led to wars between England and France, which were not terminated for more than 120 years. During this period France was reduced to a state of great misery. While Edward, victorious over Philip VI., and after his death in 1450 over John (II.) the Good, who was taken prisoner at Poitiers in 1456, compelled the surrender to England of some of the finest provinces of France by the Treaty of Brétigny in 1360, the country was plundered by banditti, and the Jacquerie, a mass of furious peasants (about 1358), satiated their spirit of vengeance in the blood of the nobility. Charles (V.) the Wise, who succeeded John the Good in 1364, was able to restore order only for a short time, although during this reign the English were driven out of most of their possessions in France. Then came the long and unhappy reign of the imbecile Charles VI. (1380–1422), disturbed by a rising of the peasantry and finally by foreign war, Henry V. of England having revived the claim of Edward III. to the French crown. The military successes of Henry led to the Treaty of Troyes (1420), by which he was to receive the hand of the daughter of Charles VI. in marriage, and the right of succession was settled on himself and his descendants, to the exclusion of the dauphin, afterward King Charles VII. Charles VI. died in 1422, a few weeks after Henry V., whose son Henry VI., a minor, was acknowledged as king by the greater part of France. But between 1429 and 1431, amid the licentiousness of war, of factions, and of manners, Joan of Arc animated the French in the cause of the dauphin, who was crowned as Charles VII. at Rheims, 17 July 1429, and in 1451 the English had lost all their possessions in France, except Calais.

During the wars of that period the French kings had obtained the means of wielding an almost absolute power by the institution of a standing army. It was the policy of the kings to obtain an unlimited authority by destroying the liberties of the states, and at the same time to turn the warlike spirit of the nation to foreign conquests. The despotic policy of Louis XI. (1461–83), effected this object by violence and cunning. His son and successor, Charles VIII. (1483-98), undertook the conquest of Naples (1494), to which he made pretensions as heir of the house of Anjou. After a triumphant campaign in Upper and Middle Italy he took possession of Naples; but an alliance formed between Milan, Venice, and the Pope soon after compelled him to withdraw.

Charles was the last king of the direct line of Valois, and was succeeded by Louis XII., who was descended from Louis of Valois, Duke of Orleans, brother of Charles VI. He was, on the whole, a just and beneficent ruler; but the ambition of conquest involved him in disadvantageous wars, and in the war with the league formed against him by Pope Julius II. he lost Milan and the supremacy of Genoa. On the death of Louis the crown reverted to another branch of the house of Valois, that of Angoulême, Francis I. (1515–47) being the grandson of John, count of Angoulême, uncle of Louis XII. Francis I. still continued the attempts at foreign conquest that had been made by his two predecessors, and in the great battle of Marignano, fought in 1515, he recovered Milan, with the supremacy over Genoa. But this duchy was now claimed by Charles V. of Germany, the life-long rival of Francis, and from these opposing claims there resulted five wars between France and Germany. In the first Francis was compelled to quit his hold of Milan and Genoa, and retreat across the Alps. He soon after

again invaded Italy, but was taken prisoner at the battle of Pavia (1525), and could regain his liberty only by agreeing to the Peace of Madrid (1526), in which he renounced Milan, and ceded the Duchy of Burgundy to Germany. By the Peace of Cambrai, however, concluding the second war, this duchy was restored to him (1529). The third war was concluded by the truce of Nice (1538), which left to each of the combatants whatever he happened to possess at the time. Finally, in the Peace of Crespy (1544), concluding the last war between France and Germany carried on in the lifetime of Francis and Charles, the former was allowed to retain both Burgundy and the Duchy of Savoy and Piedmont, which he had seized in the third war. Henry II. (d. 1559) pursued the same policy as his father Francis. War was renewed for the fifth time with the house of Hapsburg, then represented by Philip II. of Spain, the son of Charles V., as well as by the Emperor Ferdinand, brother of Charles. In the Peace of Cateau-Cambrésis (1559), by which the war was concluded, Savoy and Piedmont were surrendered by Henry, with the exception of a few towns which were ultimately given up by France. In the same reign Calais was recovered from the English (1558). Francis II., the husband of Mary Queen of Scots, succeeded his father Henry, but reigned little more than a year (1559–60). The foundation of the national debt, the weight of which broke down the throne 250 years later, was laid in this period. Intrigue and corruption gave to women a dangerous influence at court and in public affairs. Under the administration of Charles IX. France was inundated with the blood of Frenchmen, shed in the religious wars from 1562. These continued throughout the reign of Charles IX. and his successor, Henry III. (1574–89), and were only terminated when Henry of Bourbon, king of Navarre, and since the death of Henry III. king of France, went over to the Catholic Church (1593), having hitherto been the leader of the Huguenots.

With Henry III. had expired the last branch of the house of Valois, and Henry IV. was the first French sovereign of the house of Bourbon, which inherited its right to the throne from Robert, count of Clermont, the sixth son of Louis IX. He united to the crown of France the kingdom of Navarre, which he had inherited from his mother, Jeanne d'Albret. In his government of France Henry showed all the qualities of a great prince and a great statesman. After restoring peace to the country within and without, he granted religious toleration and full political privileges to the Calvinists by the Edict of Nantes in 1598. While cherishing the great design of founding, with the aid of the Protestant union in Germany, and other European powers, a great Christian empire offering equal political privileges to Catholics, Lutherans, and Calvinists, and thus of humbling the house of Hapsburg, he was cut off prematurely by the dagger of the fanatic Ravaillac (1610). During the minority of Louis XIII. the French policy was at first wavering, until the prime minister, Cardinal Richelieu, gave it a steady direction. He took advantage of the Thirty Years' war to humble Austria and Spain. He created that domestic despotism in France which rendered the government completely absolute, but finally occasioned the overthrow of the monarchy. Louis XIII. died in 1643, the year after his great minister. The policy of Richelieu was carried on by Mazarin during the regency of Anne of Austria, while Louis was still a minor, and also for some years after Louis was declared of age. Although enjoying the full confidence of the regent, Mazarin, as a foreigner, and, like Richelieu, the oppressor of nobles and commoners, was generally hated, which led to a rebellion and civil war (1648–53). Mazarin was compelled for a time to leave France, but soon returned more powerful than ever. In the first part of his ministry France obtained, by the Peace of Westphalia (1648), which concluded the Thirty Years' war, the German province of Alsace. The last work of Mazarin was the Peace of Pyrenees (1659), by which France received from Spain additions both in the north and in the south, 14 towns of Flanders, Hainaut, and Luxembourg.

After the death of Mazarin, in 1661, Louis XIV. took the government into his own hands, and the period which follows is the most brilliant in French history. His ministers and generals were alike the greatest of their time; and the writers of the period include the greatest names in French literature. Throughout his long reign Louis XIV. was chiefly bent on acquiring glory and increasing his empire by war. The last war of the reign of Louis XIV., the war of the Spanish Succession (1701–14), added little to the military glory of France, but Louis was nevertheless able to conclude it by sufficiently advantageous treaties. He died in 1715, leaving a national debt amounting to no less than 4,500,000,000 livres.

Louis XV., the grandson of Louis XIV., succeeded at the age of five years. During his minority the regency was held by the Duke of Orleans, who squandered in the most reckless manner the revenue of the state. It was during this period that the great Mississippi scheme was started by John Law, which created a perfect mania for speculation in France, but ultimately brought ruin on thousands of those who had a share in it, although many of the great had managed to enrich themselves by it. In 1723 Louis was declared of age. In the first part of his reign, during which he was chiefly guided by the wise minister Fleury, he was the favorite of the nation, but when he sunk under the pernicious influence of the Marquise de Pompadour, the love of his people was gradually converted into hatred and contempt. The extravagance of the luxurious and licentious court, in addition to the useless and costly wars in Germany (1740–48; Seven Years' war, 1756–63), exhausted the treasury and necessitated the increase of the taxes, which already pressed heavily on the bourgeoisie and the peasantry all the more heavily because the nobility and the clergy were exempt from taxation, and because the taxes were not raised by the government itself, but by the farmers of the revenue and their extortionate officers. During this reign two important acquisitions were made by France. These were: Lorraine, joined to France in 1766, in accordance with the treaties of Vienna of 1735 and 1738; and Corsica, bought from the Genoese in 1768, conquered in 1769.

With the reign of Louis XVI. begins the

period of expiation for the crimes of the French monarchy and aristocracy, which had culminated in the preceding reign. The fall of feudalism had left the nobility dependent on the court, but in France the people had no share in this victory. The wretched financial administration and extravagant expenditure of the court made the public taxes intolerably oppressive, at the same time that they reduced the exchequer to bankruptcy. The higher clergy were exempt from taxation, but the lower were not exempt from beggary. An army of 15,000 monks subsisted on the charity of a people which, besides the tithes of the clergy, had already given a large part of its territory to the church. Thus the court, the nobility, and the clergy formed only one privileged class united to oppress the people. The time of reaction had now come, that of repentance and reformation for the privileged orders was already past.

Louis XVI., son of the dauphin and grandson of Louis XV., ascended the throne on the death of the latter, 10 May 1774. The first difficulty of his government, and the rock on which it split, was the hopeless and unmanageable condition of the public finances.

War broke out with England, in consequence of the support afforded by France to the revolted American colonies of Great Britain. A treaty of commerce and alliance with the United States was signed 6 Feb. 1778, and was followed by an immediate declaration of war by England. The war was successful in its immediate object, and was terminated by the Treaty of Versailles, 3 Sept. 1783. Three years afterward a commercial treaty was concluded with England.

A fatal result of the weakness of the king was that the queen, who was naturally of a firmer temper, began to take an interest in the government. Her influence, not being legitimate, necessarily took the form of intrigue, and made her the centre of the reactionary tendencies of the court and the privileged orders; thus exciting the jealousy and suspicion of the lower orders, and arousing against her a hatred without bounds, and which, in spite of her private virtues, could not be satiated until both her husband's blood and her own had stained the fall of the monarchy.

Financial and political discord became rife and in June it became necessary to bring foreign troops to Paris to overawe the assembly. The people demanded arms, which the municipality of Paris supplied; and on 14 July the Bastille was captured and destroyed. The *garde bourgeoise*, formed by the municipality, was now transformed into the national guard. The command was given to Lafayette, who formed its colors by placing between blue and red the colors of Paris, white, the emblem of the French monarchy. Thus was originated the flag of the republic. The spirit of insurrection in the meantime had, since the beginning of 1789, been spreading in the provinces, and the urgency of affairs induced the assembly, on 4 August, to take a decisive step. On the basis of a future compensation all privileges were abolished. A banquet given to the foreign troops at Versailles at a time when the populace was threatened with famine, excited another insurrection. Versailles was attacked by the mob, and the king brought a prisoner to Paris (5 and 6 Oct. 1789). On this occasion, as on the taking of the Bastile, the ferocity and bloodthirstiness of the more lawless portion of the mob began to be fearfully manifested. This popular outbreak occasioned also the beginning of the emigration, so fruitful in future disasters to France. The king's brother, the Comte d'Artois, and others of his more extreme councilors, fled, and by transferring their intrigues to foreign courts, hastened the Revolution, and prepared the way for the devastating wars by which it was followed.

In December 1790, the king began to correspond secretly with foreign powers, and a secret convention had been made with Austria, Prussia, Piedmont, Spain, and Switzerland, to advance their troops to the frontiers with a view to a simultaneous occupation of the territory. To give effect to this plan it was necessary that the king should be free. In concert with the Marquis of Bouillé, who commanded the troops in the north of France, Louis made his escape from Paris (20 June 1791), and endeavored to reach Montmédy; but he was recognized on the road, arrested at Varennes, and brought back to Paris escorted by the commissaries of the assembly. A demonstration in the Champ de Mars, in favor of his deposition (17 July), was put down by force by Lafayette and Bailly, under order of the assembly. The popularity of that body, already declining, was seriously compromised by this step, but its labors were now drawing to a close.

On 30 Sept. 1791, it brought its work to a finish, after having redeemed its oath of 20 June. The constitution was sworn to by the king on 14 September, after which he was reinstated in his functions. The constitution embraced all those civil reforms which, afterward incorporated in the code Napoleon, survived the political changes of the Revolution. It deprived the king of arbitrary powers, and voted him a civil list; it provided liberty of worship, freedom of the press, of commerce, of industry; the laws of primogeniture and entail were abolished, and equal division of property among children made compulsory; confiscation of property for offenses was abolished, and personal punishment substituted; titles were abolished; the clergy were reduced to public functionaries, salaried by the state; the territory of France was declared free through all its extent, and a re-division of it was effected (15 Jan. 1790) into 83 departments. This division afterward proved an admirable instrument of centralization, and in repeated emergencies enabled Napoleon at once to lay his hand with ease upon all the military resources of France. With some excesses these measures swept away at one stroke all the real grievances which supplied the motive force of the revolution, and could they have been peaceably maintained it might have ended here. But they were the result of a sudden flood of enthusiasm which took no account of opposition, and which had only dispossessed and not destroyed the rival interests. One of the measures already mentioned in particular demands further details, as it was the means of meeting the financial difficulty, and at the same time of arming the enemies of the Revolution, at whose expense it was effected. On 2 Dec. 1789, the domains of the church were, in the euphemism of the assembly, put at the disposition of the nation. The minister was authorized to sell these estates to the extent of 400,000,000 livres. Until the sale was effected he

was authorized on the security of these national domains to issue a paper money having a forced circulation and a preference in the purchase of them. In 1792 the estates of the emigrants were confiscated in like manner. Thus was created that seemingly inexhaustible treasury of assignats which brought France so speedily into a financial anarchy worse than any she had yet experienced. Among other reforms was the reorganization of the administration of justice. The parliaments were dissolved by indefinite prorogation, and judicial functions were separated from the administrative, district courts were created and judges appointed for 10 years. The assembly closed with an attempt to recall the émigrés, and it prohibited the re-election of its members. Mirabeau, the greatest orator of the assembly, and one of the boldest leaders of the Revolution, had died prematurely 2 April 1791, from the excesses of his life. The constituent assembly was, according to the constitution, immediately followed by the legislative assembly, which began its sittings on 1 October, but before the period assigned by the constitution it gave place to the convention. In the legislative assembly there were two parties of political importance, the Girondists, who led it, and the Montagnards, who subsequently became all-powerful in the convention. The royalists were already powerless. The assembly was compelled at once to take a decisive course. By the declaration of Pilnitz the emperor of Germany and the king of Prussia threatened an armed intervention to restore Louis to his rights. The king was compelled in March to accept a Girondist ministry, and on 20 April 1792, war was declared against the empire. The first attempts to assume the offensive were unsuccessful. The king maintained a treasonous correspondence with the allies, and refused to sanction the decrees of the assembly. On 20 June, the people invaded the assembly and the Tuileries, and summoned the king to sign the decrees. He refused, but satisfied them for the moment by allowing himself to be crowned with a red bonnet. On 26 July the Duke of Brunswick issued his celebrated manifesto, threatening, if the king was insulted, to deliver Paris to a military execution. The sections of Paris retorted by signing a petition demanding the deposition of the king before the close of the day (9 August). At midnight the tocsin sounded. The Tuileries, after a sanguinary combat, were taken and sacked. The king took refuge with his family in the assembly, which was invaded and compelled to submit to the dictation of the victors by assenting to the suspension of the king and the convocation of a national convention. The convention was an extraordinary assembly, summoned for an emergency, and thus recognized the fact that France was again without a constitution. The war now assumed a more favorable aspect. The victory of Valmy, 20 September, freed France of its invaders; that of Jemappes, 6 November, led to the occupation of Belgium.

The first act of the new assembly was to proclaim the republic. On 3 December the king was cited to appear before it. On 20 Jan. 1793, he was, by four successive votes, sentenced to death within 24 hours, and on the 21st the sentence was executed. This violent inauguration of the republic shocked public opinion throughout Europe, and armed the neutral states against France. England, Holland, Spain, and the empire joined the coalition. A levy of 300,000 men was ordered. It was necessary to send some of these new levies to suppress the Chouan insurrection in Maine, Anjou, and Brittany. Nearly all the officers of rank had emigrated, and Dumouriez, after being defeated at Neerwinden (18 March), had declared against the convention. The army lost confidence in its heads and became disorganized. Mutual suspicion and distrust reigned in the convention itself. The convention took measures suited to the gloomy aspect of affairs. A revolutionary tribunal was appointed to try offenses against the state, a committee of public safety, with sovereign authority, was appointed (6 April), and the convention renounced the inviolability of its members. The period thus inaugurated is known in history as the Reign of Terror. The struggle between the Girondists and the Montagnards became violent. The later, defeated in the convention, armed the sections of Paris. The convention, under pressure, ordered the arrest of 31 Girondists (2 June). Some of them escaped and excited insurrection in the provinces. A new constitution was adopted by the convention on 23 June, called the Constitution of the Year 1, the Republican Calendar being adopted on 5 Oct. 1793. In the meantime the majority of the southern towns declared against the convention, the French territory was invaded both on the north and south, and to all these dangers was added famine. The convention fixed a maximum price for the sale of provisions. A decree was passed excluding English manufactures from France. A levy was ordered of 1,200,000 men, and Carnot organized 14 armies. The revolted provinces were speedily reduced. Bonaparte took Toulon from the English; and Jourdan, as commander-in-chief of the army of the north, was put in a position to oppose the principal forces of the coalition. The energy of the dominant party had risen to the danger, but it was accompanied by a ferocity without example. The revolutionary tribunal had already filled the prisons with victims. On 10 October the constitution was suspended and the government declared revolutionary, a term which included unlimited power. Both in Paris and the provinces executions and massacres followed each other daily, and as new parties succeeded each other in the convention the leaders of the defeated parties were added to the usual list of suspected royalists or reactionaries. Thousands of paid committees were formed throughout France. The queen was executed on 16 October, the Girondists on 31 October, the Hébertists on 24 March 1794, the Dantonists on 5 April. Robespierre had a new law passed on 22 Prairial (10 June) to facilitate these executions, and from this date to 27 July 1400 persons are supposed to have perished. At length the Reign of Terror came to an end by the execution of Robespierre and his associates on 27 and 28 July.

The campaigns of 1793 and 1794 resulted favorably to the French arms. The allies made war on the old system of position and detail, and permitted the French, by a better concentration of their forces, to gain some decided advantages. Jourdan defeated the Prince of Coburg at Wattignies 15 and 16 October. Hoche wintered in the Palatinate. In Italy and Spain the French had also been able to carry the war beyond their own frontiers. In 1794 Pichegru, by

the victory of Fleurus, recovered Belgium, and by the beginning of 1795 had completed the conquest of Holland, which, under French influence, constituted itself into the Batavian Republic. By the successes of Jourdan the allies were driven across the Rhine, and Spain was invaded. These successes induced Prussia and Spain to lay down their arms. By the treaties of Basel, signed by the former on 5 April, by the latter on 12 July (ratified 22) 1795, these countries acknowledged the French Republic. The English had been successful at sea, and had made extensive captures among the French colonies.

In 1795 the convention gave the republic a new constitution, a chamber of Five Hundred to propose the laws, a chamber of Ancients to approve them, an executive of five members, one elected annually, called the Directory. This tame bequest of that once terrible assembly marked the progress of a strong reaction. The royalists conceived sanguine hopes of a restoration. Pichegru was gained, a royalist insurrection organized, and 30,000 men marched on the Tuileries, where the convention sat. Barras entrusted the defense to Napoleon, who, with 5,000 men and his artillery, repulsed the insurgents. This event is called the affair of the 13th Vendémiaire (5 Oct. 1795). Bonaparte was now appointed under Barras to the command of the army of the interior. The convention was dissolved on 26 October.

In the campaign of 1796–97, organized by Carnot, Jourdan, and Moreau, each with 70,000 to 80,000 men, were to enter Germany to reach the basin of the Danube, the first by the valley of the Main, the second by that of the Neckar, and to descend upon the hereditary states of Austria; while Napoleon, with 40,000 men, menaced Italy. One object of the campaign was to make the armies live on foreign territories. Bonaparte's lieutenants in Italy were already experienced generals. He assembled them and unfolded his plans, which silenced the jealousy naturally caused by his appointment. To the soldiers he issued the first of his rousing proclamations: "You are ill-fed," he said, "and almost naked; the government owes you much, and can give you nothing. I am about to lead you to the most fertile plains in the world, and to opulent cities where you will find honor, glory, and riches." During four years the army had been struggling against the Sardinian and Austrian troops, without decisive success, on the southern slopes of the Alps and Apennines. The Sardinians stretched from the Bormida to the Stura, with an entrenched camp at Ceva. The Austrians were cantoned in the neighborhood of Alessandria and Tortona, commanding the roads to Genoa and Milan. Napoleon threatened an attack on Genoa by Voltri, but made his real advance through the valley of the Bormida. By seizing Montenotte he placed himself in their centre; and having first repulsed the Austrians, drove the Sardinians before him to Cherasco, where an armistice was concluded (28 April), which was converted, on 15 May, into a definite treaty, by which Sardinia renounced the coalition and ceded Savoy and Nice to France. Bonaparte now turned upon the Austrians, and by forced marches to Piacenza compelled Beaulieu to retreat toward the Tyrol. He crossed the Po at Piacenza, stormed the Bridge of Lodi, which was held by the Austrians to cover their retreat, and entered Milan on 15 May. Brescia was entered on the 28th, the passage of the Mincio forced at Borghetto on the 30th; and the Austrians, after garrisoning Mantua, retired into the Tyrol. Napoleon followed up his successes by negotiations with the Italian princes and the Pope, upon whom he levied contributions. The king of Naples signed an armistice on 5 June. Besides money, so much wanted by the directory, Napoleon provided a pleasing tribute to French vanity by stipulating for the surrender of pictures, manuscripts, and works of art. On Lombardy he levied a contribution of $400,000,000; the Pope promised $420,000,000. He sent $200,000,000 to the directory, which had not been able to defray the expenses of his campaign. While he besieged Mantua, a fresh army of Austrians under Wurmser advanced against him in three divisions. He raised the siege, beat one division under Quosdanovich at Salo and Lonato, 3 August, and another under Wurmser at Castiglione, on the 5th. Wurmser, reinforced to 50,000 men, again attempted to relieve Mantua. Napoleon, who had entered the Tyrol and had reached Trent after defeating 25,000 Austrians under Davidovich at Roveredo, descended the valley of the Brenta after Wurmser, defeated him at Bassano (8 September), and shut him into Mantua. In the meantime the Archduke Charles had defeated Jourdan and forced Moreau to retreat by the Black Forest to Alsace, which he reached in October. This enabled the Austrians to send a fresh army after Napoleon, consisting of 50,000 men, under Alvinczy and Davidovich. After sustaining a repulse at Caldiero, Napoleon outmanœuvred Alvinczy and defeated him at Arcole, 15–17 November. In January 1797 Alvinczy, with large reinforcements, again advanced from Roveredo to the relief of Mantua. Napoleon defeated him on the 14th, at Rivoli. On 2 February he received the surrender of Mantua. Bonaparte now put an end to his armistice with the Pope, and invaded the States of the Church. A speedy understanding was come to by the Treaty of Tolentino (19 February); the Pope surrendered Avignon, Bologna, Ferrara, and the Romagna to France; these were added to the provinces of Modena and Reggio, taken from the Duke, and formed the Cispadane Republic, as, after the battle of Lodi, Lombardy had been proclaimed as the Transpadane Republic. The Austrians were preparing for another invasion of Italy under the Archduke Charles, and Napoleon resolved to anticipate them before they should receive their reinforcements from the armies on the Rhine. He entered the Tyrol, driving the Archduke before him, and had reached Judenburg, a few days' march from Vienna, when an armistice was accepted (7 April) and preliminaries were signed on the 18th, at Leoben, ceding the Austrian Netherlands and Lombardy to France, and indemnifying Austria with Venetia. These preliminaries were confirmed by the Treaty of Campo Formio, signed 17 October.

In the meantime the internal condition of affairs was becoming worse. The Reign of Terror had been followed by an excessive dissolution of manners. Brigandage prevailed in the provinces. Barras, a member of the Directory, and other high officials, had been guilty of malversation and private jobbing in the public

funds. The returned royalists were intriguing for a counter-revolution. The reactionary party had triumphed in the elections of May 1797, and had succeeded in electing Pichegru president of the Five Hundred, and Barbé Marbois, another royalist, president of the Ancients, and had replaced Letournerre in the directory by Barthélemy. The majority of the directory, relying on the support of Bonaparte, resolved to anticipate them. On the night of 4 September 1797, Augereau introduced 12,000 men into Paris, surrounded the halls of the councils and arrested the leaders of the reactionary party. The minorities of the two councils, assembled on the invitation of the directors, condemned 53 deputies to transportation; annulled the elections in 48 departments, and repealed the laws which had been passed in favor of priests and emigrants; and other violent measures were also taken. Moreau, who had betrayed the intrigues of Pichegru, was himself suspected, and deprived of his command.

Napoleon, who was named general of the army of England, persuaded the directory to abandon the project of a descent on England, and proposed, as a means of ruining her Indian empire, the conquest of Egypt. The army appointed for this expedition, consisting of 36,000 men, embarked at Toulon 10 May 1798. In passing, they took Malta from the knights. While Napoleon was occupied with the conquest of Egypt, Nelson, who had pursued the French fleet, found it moored in the Bay of Abukir, defeated, and nearly destroyed it. The French were thus already imprisoned in their conquest, the political value of which was confiscated in advance. After the battle of the Pyramids (21 July) the subjugation of Egypt was easily effected, and early in the following year Bonaparte proceeded to the conquest of Syria. After traversing the desert, and capturing Gaza and Jaffa, where he massacred the garrison, he laid siege to the city of Acre, which was defended by a Turkish garrison, assisted by the English commodore, Sir Sydney Smith. After 60 days' siege he was compelled to relinquish the attempt to capture this place and return to Egypt. On 22 August, in consequence of advices from Europe, he abandoned the command of the army to Kléber, and embarking in a frigate landed at Fréjus 9 October. A second coalition had by this time been formed against France, embracing England, Russia, Austria, and other German states, Naples, Portugal, and Turkey. To meet this danger the councils passed the law of the conscription (5 Sept. 1798), and ordered a levy of 200,000 men.

The campaign of 1799 was disastrous to the French. Jourdan, who had crossed the Black Forest, was defeated by the Archduke Charles on 25 March, and forced to retire beyond the Rhine. Schérer, who was intrusted with the command of the army of Italy, was defeated at Magnano on 5 April. Moreau, who superseded him, sustained further reverses; and MacDonald, who came to his assistance with the army of Naples, was totally defeated in the battle of the Trebbia, 17–19 June. Joubert, who succeeded Moreau, was defeated and killed at Novi 15 August. On the other hand, the Anglo-Russian campaign in Holland had failed; and Masséna, after a brilliant campaign in Switzerland, defeated the Russians and Austrians at Zurich on 25 September, which induced the Emperor Paul I. to make peace.

Napoleon, on his return, found the government in great embarrassment. Its credit was wholly gone. It was obliged to fund the interest of its debts or pay it in worthless paper money. It was ill-obeyed by its generals. A revolution had taken place in the government (18 June), but the new directors were as incompetent as the old. In these circumstances was accomplished the revolution of 9–10 Nov. 1799. The councils being alarmed with rumors of a Jacobin plot, the Ancients gave orders that both bodies of the legislature should be transferred to St. Cloud under the conduct of Bonaparte, who was entrusted with the command of the troops. Bonaparte had already secured the co-operation of Moreau and the other generals present in Paris. On the 10th Napoleon entered the Council of the Ancients assembled at St. Cloud, and insisted on the necessity of a new constitution. On proceeding to the Council of the Five Hundred he was received with cries of *à bas le dictateur*. Gen. Leclerc, by his orders, entered and dispersed the assembly. The members of the two councils who were favorable to Bonaparte then appointed a provisional government of three consuls — Bonaparte, Siéyès, and Roger Ducos, and a committee consisting of 25 members, of each council to draw up a new constitution, which was proclaimed on 15 December. The three consuls were appointed for 10 years, and re-eligible The first had all the executive powers, the others only a consultative voice. This constitution was submitted to the approbation of the people, and accepted by 3,011,107 suffrages against 1,567. The departments were put under prefects directly responsible to the minister of the interior. The prefects, sub-prefects, and maires of communes had all their councils, which were merely consultative, the whole executive power being in the hands of the officer responsible to government. Bonaparte chose Cambacérès and Le Brun as second and third consuls. He revoked the conscriptions, and made efforts to conciliate both Royalists and Jacobins. He wrote letters to the king of England and the emperor urging, in theatrical terms, the restoration of peace. Napoleon's overtures of peace being refused, his next business was to prepare for war. He gave Moreau the command of the army of the Rhine, and determined himself to proceed to Italy. Masséna, with the remains of the French army, was shut up in Genoa. He crossed the Alps, and defeated the Austrians at Marengo on 14 June 1800. By the Convention of Alessandria, signed on the 16th, Melas abandoned all Piedmont and Lombardy, to the Oglio. Napoleon then committed the command to Masséna and returned to Paris. Moreau defeated the Austrians in several engagements during May, and forced them to take refuge in Ulm. The rest of the year was divided between campaigning and negotiating; but the latter having proved fruitless, Moreau again defeated the Austrians under the Archduke John, on 3 December, in the decisive battle of Hohenlinden. Brune, who succeeded Masséna, extended the Italian conquests in Tuscany and Venetia. Negotiations were then entered on by Austria, and the Peace of Lunéville concluded 9 Feb. 1801. The Rhine was recognized as the boundary between France

and Germany. The Adige was to be the boundary of Austria in Italy. The independence of the Batavian, Helvetian, Cisalpine, and Ligurian republics was guaranteed. A treaty was also concluded with Spain at Madrid on 21 March; and by the Treaty of Florence, 28 March, Naples agreed to renounce the coalition, and received French garrisons. Russia, Prussia, Denmark, and Sweden, formed an armed neutrality in opposition to the naval privileges claimed by England, which now maintained the war single-handed. This led to a brief war between England and the northern powers, except Prussia, which was terminated by the death of Paul I. On 31 August, Gen. Menon, by a capitulation with the English, agreed to evacuate Egypt. Both England and France were now anxious for peace. Preliminaries were signed on 1 October, and the Peace of Amiens was concluded 27 March 1802. France retained her continental conquests. Ceylon was ceded to England by Holland, and Trinidad by Spain; all the other conquests of Great Britain were restored. Malta, which had been taken by the English, was to be restored to the Knights of St. John.

Napoleon exhibited his wonted vigor in home administration. By means of the senate he silenced the opposition of the tribunate and the corps législatif. He superintended the preparation of the Code Civil. He entered into a concordat with Cardinal Consalvi for the re-establishment of the Catholic religion. He undertook public works, constructed roads and bridges, encouraged agriculture, manufactures, and commerce. On 2 Aug. 1802, Napoleon and his colleagues were made consuls for life, and the constitution was amended.

The external policy of Napoleon was not calculated to conciliate the jealousies caused by the extension of French dominion. The independence of the new republics was merely nominal. The duchy of Parma and the island of Elba were occupied, and an armed intervention changed the government of Switzerland. By the Treaty of Lunéville the German princes dispossessed by the advance of the French boundary were to be indemnified beyond the Rhine. The process of compensation was not carried out with sufficient promptitude for Napoleon. By his interference, in conjunction with that of the emperor of Russia, the indemnification was effected by the extinction of the two electorates of Cologne and Trèves, and the secularization of the ecclesiastical estates. Napoleon occupied St. Domingo, and sold Louisiana to the United States for $15,000,000.

The discontent excited in England by this aggressive policy made it evident that the peace could not be maintained, and the government refused to evacuate Malta. On 16 May, two days before the declaration of war, an embargo was laid on all French and Dutch vessels in English harbors. Napoleon retaliated for this lawless proceeding by seizing as hostages all English travelers in France and Holland, and detaining them as prisoners till the peace, and Gen. Mortier took military possession of Hanover. Russia and Prussia attempted to intervene, but on terms unacceptable to France. Spain and Portugal had to purchase their neutrality from France; but as this purchased neutrality placed the former at the disposal of France, England declared war with Spain. Naples was occupied by French troops, and vast preparations were made ostensibly for the invasion of England.

A conspiracy for the overthrow of Bonaparte and the restoration of the Bourbons was discovered in 1804, in which the British government was implicated. The most distinguished of the conspirators were Cadoudal, Pichegru, and Moreau. Cadoudal was executed, Pichegru destroyed himself in prison, Moreau was pardoned, and retired to the United States.

The legislative bodies were now completely subservient to Napoleon, and the conspiracy of Cadoudal was made a pretext for offering him the empire, in order to assure the permanence of the government by giving it a hereditary head. The senate addressed him by a deputation, and on being invited to express their opinion voted the hereditary empire with four dissentient voices. In the council of state seven members supported the republic; in the tribunate there were only a few dissentients, among whom was Carnot. The *senatus-consultum* for the regulation of the empire, drawn up by Napoleon himself, was passed 18 May 1804. The empire was confirmed by a popular vote of 3,572,329 against 2,569. The empire was made hereditary in the male issue of Napoleon and his adopted sons, his brothers Joseph and Louis following in the order of succession. The emperor was to have absolute authority over the imperial family. A new aristocracy, not yet hereditary, was created. After the emperor came the grand dignitaries of the empire. The senate, besides 80 members elected by itself, was to comprise the six grand dignitaries of the empire, and the princes of the blood after 18 years of age. A high imperial court was constituted to take cognizance of crimes against the safety of the state, the person of the emperor, and of offenses committed by ministers or great persons of the state. On 4 July Napoleon distributed at the Hôtel des Invalides the grand decorations of the Legion of Honor, instituted two years before, to the chief personages of the empire. On 16 August he gave the crosses of the Legion to the soldiers in the camp of Boulogne, where in sight of the English fleet the preparations were going on for the invasion of England. The Pope was invited to the coronation of Napoleon, which took place at Notre Dame on 2 Dec. 1804. The emperor, after receiving the sacred unction from the Pope, crowned himself, and afterward the empress. On 26 May 1805 he was crowned king of Italy.

Pitt had in the meantime been organizing another coalition against France. A treaty was concluded between England and Sweden on 3 December. The Emperor Alexander, who had in the previous year strongly remonstrated against the usurpations of the French government, and withdrawn from diplomatic relations with it, joined the allies on 11 April 1805. Austria, which had long taken part in the consultations of the league, formally acceded to it on 9 August. Austria had delayed to the last her adhesion to the coalition, because on her the brunt of the war was certain to fall. Prussia remained neutral. Austria opened the campaign with a powerful army in Italy under the Archduke Charles, and a German army under Gen. Mack. A Russian and Swedish army was to operate in north Germany, and two Russian

armies of 60,000 each were to join Mack on the Danube. The Austrian army crossed the Inn and entered Bavaria, which was in alliance with France, on 9 September. Mack, who had about 80,000 men, without waiting for the Russians traversed Bavaria and took up a position on the Iller. Napoleon, who had resolved to deliver his principal attack in Germany, where the Austrians were weakest, turned Mack's right and crossed the Danube in his rear, and having cut off his communications shut him up in Ulm. Defeated in his attempts to escape the toils, particularly by Ney at Elchingen (14 October), Mack capitulated with all his forces on 19 October. On 13 November Napoleon entered Vienna, where he found himself between two armies. On the right that of the Tyrol and Italy, which the Archduke Charles had led back in consequence of Mack's disaster, followed by Masséna, on the left the Austro-Russian main army with the two emperors (Austria and Russia) in Moravia. He moved immediately against the latter, and arrived at Brünn on 20 November, encountered the Austro-Prussian army, which was superior in number, at Austerlitz on 2 December, and inflicted on it a decisive defeat. An armistice was immediately concluded, and the Peace of Presburg, between France and Austria, signed on 26 December. Austria surrendered Venetia, Istria, and Dalmatia to France, the Tyrol to Bavaria, and Suabia to Würtemberg and Baden. The title of king was assumed by the electors of Bavaria and Würtemberg, and of grand-duke by the elector of Baden. Napoleon was now able to carry out the plan he had contemplated of giving his empire a hereditary nobility. Joseph Bonaparte was created king of Naples and Sicily; Louis, king of Holland; Eliza, Duchess of Lucca; Pauline, Duchess of Guastalla; Talleyrand, Prince of Benevento; Bernadotte, of Pontecorvo; Berthier, of Neufchâtel; Murat, Grand-duke of Berg. Other territorial titles were bestowed upon his marshals and generals, and domains with hereditary succession set apart for their maintenance. While this great success was being achieved, Nelson in the battle of Trafalgar, 21 Oct. 1805, had almost annihilated the French and Spanish fleets. The Confederation of the Rhine, a league of German princes, under the protection of France, was signed at Paris on 12 July 1806. On 6 August Francis II. abdicated the title of emperor of Germany, the empire having been *de facto* dissolved.

Negotiations had been going on for peace with Russia; but the dissolution of the German empire determined Alexander to continue the war. The formation of the Confederation of the Rhine was also looked upon as an affront by Prussia, and when Napoleon offered to restore Hanover, which he had bestowed on Prussia as the price of peace to England, the king and people were filled with rage, and war was determined on regardless of the hazardous circumstances in which it was undertaken. War was declared on 8 October. Napoleon was already at Bamberg directing his troops which had not left Germany. On the 14th the two armies met at Jena and Auerstädt, when the Prussians were totally defeated. Napoleon entered Berlin on 27 October. Here he dictated on 21 November the celebrated decree declaring the British Isles in a state of blockade. All commerce in English articles was forbidden, all Englishmen on the Continent were rendered liable to arrest. A Russian army, about 90,000 strong, had already entered Prussian Poland. Napoleon arrived at Warsaw on 15 December, but nothing decisive occurred till the beginning of the year. The battle of Eylau, which was claimed as a victory on both sides, but which checked Napoleon's progress, was fought on 8 Feb. 1807. The surrender of Dantzig having relieved a large body of French troops engaged in besieging it, a new campaign was begun, and on 14 June a decisive victory was gained by the French at Friedland. Separate armistices were immediately entered into with Russia and Prussia, and the Peace of Tilsit was concluded 7–9 July. Prussia was compelled to cede nearly the half of her territory. The kingdom of Westphalia was formed for Jerome Bonaparte of Hesse Cassel and the Prussian provinces west of the Elbe; the grand-duchy of Warsaw for the king of Saxony of the Polish provinces of Prussia — some minor cessions were made in favor of Russia and other powers, and the Prussian army was restricted for 10 years to 42,000 men. Russia recognized the new kingdoms created by Napoleon, and the Ionian Republic, of which Russia had guaranteed the independence, was given up to France. To secure the connivance of Alexander in his ambitious designs, and especially his co-operation against England, Napoleon gave up Finland to Russia, and she was encouraged to hope for the Danubian provinces of Turkey. Napoleon's idea seems to have been that the two emperors should divide between them the dominion of the civilized world; but he soon showed that he could not admit a partner except as a dependent. In the meantime the mediation of Russia was formally accepted for the negotiation of a peace with England, and that of France for a peace betweeen Russia and Turkey; failing these, an offensive and defensive alliance was concluded, and a rigorous enforcement of the continental blockade was imposed both on Russia and Prussia.

The Peace of Tilsit led immediately to war between England and Denmark. Assured that the latter could not maintain her neutrality, the former insisted upon an alliance by which Denmark should be placed under the protection of Great Britain, her fleet carried to England for security, and her territory guaranteed. These extraordinary demands, which nothing but an extreme exigency could justify, were not complied with. Copenhagen was bombarded by the English fleet for three days, from 2 to 5 September, and the Danish fleet and naval stores carried to England. The war between England and Denmark continued till 1814. Russia offered her mediation to England, but declined, on the invitation of the English cabinet, to communicate the secret articles of the Treaty of Tilsit, and re-proclaimed the armed neutrality. War was consequently declared, and for five years Russia continued in the French alliance, and in hostility with England.

Portugal had generally joined the confederacies against France, and Napoleon now determined to occupy it, with the intention also of overthrowing the government of Spain, which he could not trust; but in the meantime he entered into an alliance with Spain for the partition of Portugal. Junot entered Lisbon

30 Nov. 1807, with the advance guard of the French army. The Pope being unwilling to carry out the continental blockade, and refusing to recognize Joseph as king of Naples, Rome was occupied, 2 Feb. 1808. The French troops had already entered Spain before the end of 1807; and in March 1808 Murat with 100,000 men marched upon Madrid, which was entered on the 23d. By the Treaty of Bayonne, signed 5 May, Charles IV. resigned the crown of Spain, which Napoleon gave to his brother Joseph. The sovereignty of Naples was bestowed upon Murat. The Spaniards, whose government had been disposed of without their consent, everywhere rose in insurrection, and the military occupation of all the provinces of Spain became a necessity. The French troops met with various reverses. At Baylen, on 22 July, Dupont was compelled to capitulate with 18,000 soldiers. A British force, under Sir Arthur Wellesley, landed at Mondego Bay, defeated Junot at Vimeira, 21 August, and compelled him to evacuate Portugal by the Convention of Cintra on the 30th. The progress of the Spanish insurrection brought Napoleon with fresh forces to Spain, and after successful engagements at Burgos, Espinosa, and Tudela, he entered Madrid on 2 December. He immediately decreed the abolition of the inquisition, the suppression of two thirds of the convents, the cessation of feudal rights, and the abolition of internal customs.

The occupation of Napoleon in Spain gave Austria the opportunity she awaited of breaking the Peace of Presburg. On 27 March 1809 a declaration of grievances suffered since the Peace was delivered to the French government, and on 10 April the Austrian army crossed the Inn and occupied Bavaria. Napoleon, who had returned from Spain to prepare for the encounter, defeated the Austrians at Eckmühl on 22 April, and immediately advanced to Vienna. The Archduke Charles after his defeat also marched toward Vienna on the opposite bank of the Danube, and took up a position a short distance to the north of the capital. The French seized the island of Lobau, and throwing a bridge across the Danube, encountered the Austrians in the bloody and indecisive battles of Aspern and Essling. The French were forced after great loss to return to the isle of Lobau, which Napoleon fortified, and awaited the approach of Eugène with the army of Italy. On 5 July he debouched with 150,000 men on the left bank, and on the 6th defeated the Austrians in the battle of Wagram. An armistice was signed at Znaim on 11 July, and on 14 Oct. 1809 was signed the Peace of Vienna (Schönbrunn), in which the cessions of the Treaty of Presburg were confirmed, and further cessions of territory made to France and her allies.

Napoleon was divorced from Josephine on 16 December, and married Maria Louisa of Austria by proxy, 11 March 1810. The "king of Rome" was born 20 March 1811.

The war continued in Spain throughout all the provinces. Saragossa had surrendered after a memorable siege on 20 Feb. 1809. The mutual jealousy of Napoleon's marshals, bound to the service of an ambitious master rather by the tie of self-interest than of patriotism, always interfered in his absence with the unity of their operations; but the force wielded by them was too great for the undisciplined and ill-organized bands of the Spanish junta. In Portugal a somewhat better organization prevailed. A forced levy was made, and 24 regiments were taken into British pay. Sir Arthur Wellesley landed at Oporto with an English force on 22 April 1809, and, uniting with the Portuguese under Beresford, compelled Soult to evacuate Portugal. He then formed a junction with the Spanish general Cuesta, and marched on Madrid. He met the forces of Joseph under Victor and Jourdan at Talavera de la Reina, 27–28 June, and defeated them; but the advance of Soult, Ney, and Mortier to the protection of the capital compelled him to retreat to Badajoz.

In 1810 Napoleon, freed from other wars, had concentrated an overwhelming force in the Peninsula, and Wellington defended himself in his famous lines of Torres Vedras, near Lisbon, into which he retired in October, after contesting every position on the way. He was followed by Masséna, who, in the beginning of March 1811, was compelled to retire by want of provisions. Wellington followed, and defeated him at Fuentes de Onoro on 3 and 5 May. On 16 May Soult was defeated by Beresford at Albuera. Suchet had in the meantime been carrying on a successful war in Catalonia, and earned his marshal's baton by the capture of Tarragona. Wellington captured Ciudad Rodrigo on 19 Jan. 1812, defeated Marmont at Salamanca on 22 July, and entered Madrid on 12 August. While these events were going on, war was preparing elsewhere on a larger scale. The continental system had been insisted on with such rigor that his brother Louis resigned the throne of Holland, 3 July 1810, rather than carry out his instructions, and Holland had been united to France. The Milan decrees (17 Dec. 1807) declared every vessel which had touched at an English port to have lost its nationality, and ordered all English merchandise found on the Continent to be burned. It now became more than ever an object with Napoleon to shut the ports of Russia, and he insisted upon this in as harsh and arbitrary a manner as if Alexander had been his vassal. So oppressive had the system become that Napoleon himself had been compelled to issue licenses for trade between France and England. From the close of 1810 Russia had partially departed from the blockade by admitting colonial produce in neutral vessels. Napoleon demanded that such vessels should be confiscated. Russia, he said, must return to the position of subordination in which it was placed by the Treaty of Tilsit. The czar on his part had entered into an alliance with Sweden, of which country Bernadotte had been elected crown-prince, and secured peace with Turkey; and on 8 April 1812 he demanded the evacuation of Old Prussia, the duchy of Warsaw, and Swedish Pomerania, and a relaxation of the continental system.

In the war now imminent Prussia and Austria entered on compulsion into the alliance of France, with the obvious intention of deserting her whenever she should meet with serious reverses. The alternative with Austria was alliance or disarmament, and she supported France with a portion of her forces in order that she might be able at the proper moment to turn against her with the whole.

On 16 May Napoleon arrived at Dresden, and took up his residence at the royal palace, where he was waited on by the emperor of Austria, the king of Prussia, and other German princes, who expressed the utmost devotion to him. Negotiation having proved fruitless, he made here his final arrangements for the campaign. The army he had organized for it has been estimated at from 640,000 to 680,000, including auxiliary forces. The principal army of the Russians, 130,000 strong, under Barclay de Tolly, was to cover the route to St. Petersburg, resting on the Dwina; another, under Bagration, to cover Moscow on the line of the Dnieper, and threaten the flank of the invading army.

Napoleon crossed the Niemen at Kovno on 24 June, and entered Vilna on the 28th, where he was detained 17 days arranging the commissariat of his army. He beat the rear-guard of Barclay's army at Ostrovno, 25 July, and occupied Vitebsk on the 28th. Smolensk, where Barclay had formed a junction with Bagration, was captured on 17 August. The army now advanced toward Moscow; and Kutusoff, who had superseded Barclay, gave battle at Borodino on 7 September, to defend the ancient capital of Russia, where he was defeated with a loss of nearly 30,000 to the victors, and almost double that number to the vanquished. After this fatal battle the French entered Moscow on the 15th, but during the night the city, which had been deserted by its inhabitants, was found to be in flames. The conflagration lasted five days, and destroyed a great part of the city. Napoleon now attempted to negotiate with Alexander, but without result. It was impossible to pursue the Russians further, and the capture of their capital had not produced the moral effect he anticipated. Nothing remained but to retreat. He left Moscow on 19 October with 80,000 men, leaving 10,000 behind as a garrison. At Malo-Jaroslavitz, on the 24th, he had a sanguinary conflict with the Russians. On 5 November, when the army had reached Dorogubush, intense cold set in, and from this point thousands perished on the way. On 9 November only 40,000 to 50,000 men reached Smolensk, and the arrangements which Napoleon had made for victualling the army had not been carried out. Three Russian armies threatened to cut off the passage to the Berezina, which was effected with heavy loss on the 27th. At Smorgoni Napoleon quitted the army to return to Paris, leaving Murat to conduct the retreat. The remains of the army recrossed the Niemen on 20 December. Ney, who commanded the rear-guard, was the last to cross the Bridge of Kovno.

The return of Napoleon to Paris was necessitated by the impending formation of another European coalition. Austria, Russia, and Prussia had successively looked on, while each in turn had sacrificed itself to the divided counsels inspired by dread of French ascendency and of the genius of Napoleon; but now, when Russia had set the example of a heroic defense, a really European combination was to be formed against the common oppressor.

A formal declaration of war was made by Prussia on 27 March. Napoleon, availing himself of the wonderful command which the French system of conscription gave him of the resources of the country, raised a new levy of 200,000 men, and was ready before the allies. He assumed the command of the army at Erfurt on 25 April. He had still 350,000 men in Germany, and Austria did not yet deem it prudent to join the coalition. He defeated the allies at Lützen, 2 May, forced them to cross the Elbe, and entered Dresden on the 8th. On 21 May he again defeated them at Bautzen, and reached Breslau on 1 June. On the 4th he concluded an armistice for six weeks at the village of Poischwitz, near Jauer, in Silesia. As his preparation were more forward than those of the confederates, and his allies could only be depended on in the event of success, this step was of fatal omen. By the Treaty of Töplitz, signed 9 September, a formal alliance was entered into between Austria, Russia, and Prussia; but on the reopening of the campaign, 16 August, they had already aranged a joint plan of operations, and appointed Prince Schwarzenberg commander-in-chief of their combined forces. The allies could now bring from 500,000 to 600,000 men into the field, while Napoleon commanded about 360,000. The whole operations, of course, were extended over a vast area, but the main army of the allies advanced upon Dresden. The battle of Dresden (q.v.) 26–27 August, was again a victory for Napoleon, but fatal mistakes were committed, and disastrous defeats of separate corps sustained after it. The surrender of Vandamme in particular, with the remains of a corps of 30,000 men, more than counterbalanced the victory. A large portion of the French armies was composed of German troops, who were daily deserting to the enemy. On 1 October Bavaria seceded. The allied armies were gathering near Leipsic. In these circumstances Napoleon abandoned Dresden, and concentrated his army about Leipsic (15 October). He held this city with 190,000 men, while the allies with about 330,000 formed a semicircle around him. After some preliminary fighting, not disadvantageous to the French, on the 16th, the great battle of the campaign was here delivered on the 18th and 19th. Early on the first day the Saxons and Würtembergers passed over to the allies on the field of battle. On the second day the French fought only to cover their retreat, which was made more disastrous by the want of bridges over the Elster. This victory of the allies led to the retreat of the French over the Rhine, which was not effected without further combats. The fortresses held by them in Germany and Poland, which occupied 100,000 men, were gradually reduced.

Wellington in the meantime had continued his successes in the Peninsula. He defeated Jourdan on 21 June 1813, and followed Soult, who succeeded him, after a series of successful engagements, to Bayonne, which he invested in December. The southern territory of France was thus actually invaded, when, in 1814, the allies prepared for its invasion from the north. Napoleon on his return had made vigorous preparations for the invasion, and had ordered a fresh levy of 300,000 conscripts. The allies crossed the frontier in two bodies — the army of Silesia, under Blücher, crossing the Rhine; the grand army, under Prince Schwarzenberg, passing through Switzerland. Both armies entered France in January. Napoleon's defense ranks among the most skilful of his many campaigns; but in spite of the desperate

combats delivered at Vitry-le-Français, St. Dizier, Brienne, Montmirail, Arcis-sur-Aube, etc., the allies steadily advanced, and after a combat sustained in its defense by Marmont and Mortier, Paris surrendered on 31 March. Napoleon abdicated in favor of his son (6 April), but the allies required an unconditional surrender, and assigned him the sovereignty of the Isle of Elba, to which he was conveyed in a British vessel (20 April–4 May). Louis XVIII. was now proclaimed king of France, and a constitution having been arranged, the Peace of Paris was signed 30 May, and the allies immediately evacuated France.

The successes of Napoleon had disorganized the whole of Europe, and a congress had assembled at Vienna to adjust the claims of the various powers, when it was announced that Napoleon had left Elba, returned to Paris (20 March 1815), and been reinstated without resistance in his former authority. Hereupon the allied sovereigns declared him an outlaw and a disturber of the peace of the world, and renewed their alliance against him.

Napoleon had proposed to remain at peace and govern constitutionally, but his past achievements afforded no guarantee for the safety of this experiment, and he was not allowed to make it. As it was evident the allies would bring a preponderating force into the field, his only chance was to anticipate them. On 15 June he crossed the Sambre with 130,000 men to attack the English and Prussians, who were preparing to invade France on the Belgian frontier while the Austrians attacked it on the Rhine. He encountered the Prussians under Blücher at Ligny, while Ney held the English in check at Quatre-Bras (16 June). Blücher was forced to retreat, and Napoleon marched against the English, who had taken position at Waterloo. Here, on the 18th, was fought the decisive battle which resulted in his final overthrow. The allies advanced without opposition to Paris. Napoleon again abdicated in favor of his son (22 June), but being threatened by Fouché, who had assumed the direction of the government, he surrendered to the British (5 July). He was sent by the decree of the allies to St. Helena, where he died 5 May 1821.

A convention was signed (3 July), by which the French army was to retire, and the allies entered Paris. Louis XVIII. was again proclaimed, and the allies continued in military occupation of France till 1818. By the first Treaty of Paris (30 May 1814) France was reduced to her limits of 1792, with the addition of a part of Savoy, and some cantons added to the departments of the Ardennes, Moselle, Bas-Rhin, and Ain. She recovered her colonies with the exception of Tobago, Sta. Lucia, and the Isle of France (Mauritius). By the second Treaty of Paris between France and the allies she lost Philippeville, Marienburg, the duchy of Bouillon, Saarlouis, Saarbrück, the two banks of the Sarre, the country north of the Lauter and part of the county of Gex; and the Holy Alliance entered into between Russia, Austria, and Prussia became for a time a guarantee against future aggressions.

Louis XVIII. at first governed with the support of a moderate Liberal party, but the assassination of the Duke of Berri, 13 Feb. 1820, threw him into the hands of the reactionary party. Secret societies began to spread in France, with ramifications in Germany and Italy, where despotic governments also prevailed. Several insurrections took place, and some of the leaders suffered capital punishment. This ministry also undertook an expedition to Spain, to repress the opposition of the Liberals of that country to Ferdinand VII. (1823).

Louis XVIII. died 16 Sept. 1824 and was succeeded by his brother Charles X., who had always been the head of the ultra-royalist party. In 1827 a joint expedition was undertaken by England, France, and Russia in favor of the Greeks, who had thrown off the yoke of Turkey. The elections of 1827 gave a majority to the Liberals, and a moderate government was formed under Martignac. It was displaced by the Polignac ministry, a reactionary government, in August 1829. An expedition was sent against Algiers under Count Bourmont, which captured the city 5 July 1830, and formed the beginning of the French colony of Algiers. An insurection in Paris during the three days 27–29 July overthrew the royalty of Charles X., and Louis Philippe was proclaimed king, 9 Aug. 1830.

It was the policy of Louis Philippe to amuse the populace and flatter the national vanity by active foreign intervention. In 1832 an expedition was sent to drive the Dutch garrison out of the citadel of Antwerp, which should have been given up to Belgium by Holland in accordance with the Treaty of London. After an obstinate siege the French gained possession of the citadel. In the same year France seized Ancona to counterbalance the influence of the Austrians in Italy, and in 1835 the Algerine war was successfully terminated by the costly acquisition of Algeria. But by degrees the policy of the citizen king, as he was called, was changed; the government proved reactionary at home and devoid of energy abroad; the material prosperity which had marked a great part of the reign was suddenly checked by the scarcity of the harvests and the high prices of 1847. In the middle of that year Guizot, the king's chief minister, declared himself as averse to all organic changes in the state while a strong opposition was insisting on reform. At last, on 24 Feb. 1848, another bloody revolution broke out by which the Orleans family was exiled. A republic was set up without consulting the voice of the country at large. The bourgeoisie would have undoubtedly preferred the continuation of a constitutional monarchy, but for a time sailed with the stream and professed their readiness to give the republican form of government a fair trial. A so-called republican constitution was adopted, and on 10 Dec. 1848 Louis Napoleon was elected president of the French republic for a term of four years by a majority of more than 4,000,000 over Gen. Cavaignac.

The president immediately set about gaining the favor of the army, in which he was completely successful, and when the dissensions in the legislative assembly became apparently dangerous to a continuance of his arbitrary power he dissolved it, 2 Dec. 1851, and appealed to the people, asking their sanction for what he had done. Various ill-concerted attempts at armed resistance were repressed by energetic and bloody measures, and the president, who had all the elective machinery of the nation completely under his control, was confirmed in

his office for a further term of 10 years by 7,839,216 votes; and a new constitution similar to that of the Napoleonic consulate of 1799 was promulgated. At length, on 7 Nov. 1852, a senatus consultum proposed the re-establishment of a hereditary empire, and another appeal was made to the nation under the same coercive system and with similar success. On 2 December, strengthened by the votes of 7,824,129 citizens, the empire was proclaimed and Louis Napoleon declared emperor under the title of Napoleon III. In 1853, Russia having invaded the provinces of Moldavia and Walachia under the pretext of securing protection for the adherents of the Greek Church against Turkish intolerance, France and England, having guaranteed the integrity of the Ottoman empire, declared war against Russia on 27 April 1854, and sent a combined fleet to the Black Sea. The Anglo-French armies were landed in the Crimea 14 Sept. 1854, and the battles of the Alma (20 September), of Inkermann (5 November), and, finally, the capture of Sebastopol (8 Sept. 1855), led to the Treaty of Paris (30 March 1856), which secured in a great measure the objects for which the allies had gone to war. The Austrian invasion of the Sardinian states, in 1859, brought France once more into the field, as an ally of the latter. The victories of the Franco-Piedmontese armies at Montebello (20 May), Magenta, Marignano, and Solferino (4, 8, and 24 June) deprived Austria of Lombardy, which was ceded to Piedmont. The French obtained, as a recognition of their powerful assistance, the territories of Savoie and Nice (10 March 1860). In 1860 the French sent out an expedition to China to act in concert with the British, who were determined to enforce the Treaty of Tien-Tsin, by which provision had been made for the permanent residence of their ambassadors in Peking. After some severe fighting the allies entered that city on 12 October, and the Chinese emperor submitted to the terms dictated by the conquerors. Another distant expedition undertaken by France was less fortunate in its ultimate results. For some years Mexico had been the theatre of civil war carried on by the so-called clerical party headed latterly by President Miramon, and by the liberal party headed by the rival President Juarez. A temporary suspension of the payment of indemnities due to France and England led to the intervention of the European powers. It was soon evident that France had ulterior objects in view; the extravagant demands of M. de Soligny and the presence of Miramon in the French camp rendered negotiation impossible, and England and Spain formally withdrew from further intervention. In 1862 war was declared by France against Juarez, who was driven across the frontier. The government of the country was handed over to Maximilian, Archduke of Austria, who assumed the title of emperor. Supported as this prince was by French troops he could not preserve tranquillity in his dominions, and Napoleon began to recognize the grave position in which he had placed himself. The United States, moreover, who had always favored Juarez, brought strong diplomatic pressure to bear on the French emperor, and in the autumn of 1866 he began to withdraw his troops from Mexico. On the conclusion of the Austro-Prussian war in 1866 Napoleon, alarmed at the growing power of Prussia, demanded a reconstruction of frontier, claiming by way of compensation for his neutrality on that occasion Prussian territory on the Saar. This was peremptorily refused by Prussia. The ill-feeling between that nation and France was further increased in 1867, when the king of Holland signified his intention to cede Luxembourg to France. It was now, however, evident that a rupture between France and Prussia was imminent, and in 1870, on the Spanish crown being offered to Prince Leopold of Hohenzollern, France demanded that the king of Prussia should compel him to refuse it. Notwithstanding the subsequent renunciation of the crown by the German prince, war was declared by France (19 July). The disastrous surrender of the emperor and his army at Sedan (2 September) was fatal to the Second Empire. On the following day the French republic was proclaimed and the government of national defense formed. After an almost uninterrupted series of victories the Germans became masters of the French capital (28 Jan. 1871). On 26 February the preliminaries of peace were signed, by which France renounced the fifth part of Lorraine, including Metz and Thionville, and Alsace, less Belfort, and agreed to pay a war indemnity of five milliards of francs ($1,000,000,000). A definite treaty of peace was signed at Frankfort on 10 May, and on the 18th was ratified by a French assembly elected for the purpose. Meanwhile civil war had broken out in Paris, and was suppressed with great difficulty. The assembly, whose authority ought to have expired with the ratification of the peace they were expressly called together to pronounce, should now have dissolved, but this was impossible during the war of the Commune, and it was impracticable to appeal to the confused voice of the country when the pressing need was to restore tranquillity and give the nation time to think over the situation. Therefore the deputies elected Thiers, a former minister of Louis Philippe, president of the republic. The Thiers administration, which lasted until 24 May 1873, set vigorously about wiping off the war debt, and thus freeing French soil from the invaders, which was eventually accomplished in the first half of the following September. Although throughout the whole period the nation had been singularly tranquil and prosperous, and was fast attaining her former place among the great powers, the conservative faction in the assembly, professing to be alarmed at the spread of radicalism and socialism, offered on various occasions violent opposition to the government, and at last effected its fall, Thiers being succeeded by Marshal MacMahon. Under his and the preceding régime intrigues of more or less importance were carried on in the interest of one or other of the competitors for the crown, the most nearly successful being that of the adherents of the Comte de Chambord, or, as he was called by the legitimists, Henry V. This prince, however, destroyed all his chances of success by his extravagant pretensions to all the prerogatives enjoyed by his ancestors, the Bourbons. The consequence of this failure was the prolongation of MacMahon's powers as president for seven years by a vote in the assembly, 19 Nov. 1873. France, after remaining for several years without any settled form of govern-

ment, at last, in 1875, had a republican constitution drawn up for it by the national assembly elected in 1871. Its principal provisions have already been given above. MacMahon held the post of president for nearly six years, but finding his position too unpleasant to retain, he resigned, 30 Jan. 1879. Jules Grévy was elected as his successor, and he in turn was succeeded by Sadi-Carnot in 1887. The following year witnessed the culminating point of a royalist agitation under Gen. Boulanger (q.v.), which for a time threatened to overthrow the Third Republic. In June 1894 President Carnot was assassinated by an anarchist while passing through the streets of Lyons. Casimir-Perier was chosen to the vacant office, but in January 1895 he resigned, and was succeeded by Félix Faure. During M. Faure's tenure of office, which ended with his death in 1899, an alliance was concluded with Russia. He was succeeded by Emile Loubet. In 1881 France invaded Tunis and established a protectorate there. In 1883-4 possession was taken of Tonquin and a protectorate established over Anam, proceedings which led to hostilities with China. The kingdom of Dahomey was, in 1893, proclaimed a French protectorate, and in the following year the dethroned king's disaffection was suppressed by a military expedition. France had long claimed a protectorate over Madagascar, but disputes with the Malagasy government ultimately led to war, and in 1895 to the total defeat and submission of the Hovas. During the last decade of the 19th century she largely increased her possessions in north and western Africa. An attempt to occupy Fashoda and the Bahr-el-Ghazal valley in 1898 nearly led to war with Great Britain, but by a convention concluded early in 1899 she resigned her claims to the disputed territory and to Darfur and Kordofan. From 1897 till 1899 France was profoundly agitated by the demonstrations and developments which took place in connection with the attempt to secure a revision of the trial of a Capt. Dreyfus, who had been banished in 1894 for alleged treason. Revelations damaging to the heads of the army were made, and at times revolution seemed imminent.

See Bastile; Commune; Dreyfus; Franco-German War; Joan of Arc; Napoleon I.; Waterloo, Battle of.

French Language.— At the time of the conquest of Gaul by Julius Cæsar, the principal dialects spoken by the inhabitants were the Celto-Teutonic of the Belgæ, the Celto-Iberic of the Aquitani, and the Celtic proper used in the centre of the country. The Roman language overwhelmed all these idioms. It would appear that in the 4th or 5th century, the whole of Gaul, from the Rhine to the Pyrenees, with the exception of Brittany, had adopted the language of the conqueror — not the *sermo urbanus* of the classic writers, but that form of Latin which, of course with dialectical variations, had become common to all the subjugated provinces of central Europe — the *lingua Romana rustica*. On the overthrow of the Western Empire this language was modified by the mixture of words and expressions originally Frankish, Burgundian, Ostrogothic, or Visigothic. The real French language began to be developed about the beginning of the 13th century. Its sway was increased in that century by the extension of the crownlands; in the 14th by the growing authority of the house of Capet, the organization of the royal courts of justice and the parliament of Paris; in the 15th by the establishment of a military and fiscal system, but above all, by the invention of printing; and in the 16th the formal ordonnances of François I. forbade the use of any other language than French in the courts, and in public and private documents. The Académie Française established by Richelieu in 1635 for the regulation of the national language, the influence of the court, the labors of the Port Royalists and the writers of the memorable era of Louis XIV. purified, augmented, and diffused it more and more. It was first used as a diplomatic language at the conferences of Nimwegen, in 1678. Owing to its admirable clearness and precision, and its wealth of happy colloquial phrases, together with the fame of its great writers, and the important part France has continued to play on the stage of Europe, this language has now generally become the first a man of the world learns to speak after he has mastered his mother tongue.

Literature.— The earliest monuments of French literature are the productions of the Troubadours, who flourished during the 11th and 12th centuries. Their poems consist for the most part of short lyrical effusions of an amatory cast. Thibaut, the king of Navarre, sang in the service of his lady-love as a troubadour. But we cannot help looking at the poetry of this epoch as a display of ingenuity and wit, rather than as the expression of passion and deep feeling. On the other hand, the trouvères, who flourished at a somewhat later period, treated in their narrative poems (the *chansons de geste*) of national subjects, and celebrated the deeds of renowned kings and knights. These romances or chansons de geste are numerous, and have been divided into three cycles. The first narrated the deeds of the great Frankish emperor Charlemagne, his descendants and vassals; one of the oldest and best of this category of romances being the Chanson de Roland. The Armorican or Arthurian cycle consists of the poetical forms of the legends connected with ancient Britain and the achievements of the Norman warriors; the Roman de Brut, or that of King Arthur; and the Roman de Rou, or that of the dukes of Normandy, are the double foundation on which all the poems of this series rest. The third or Alexandrine cycle consists of poems in which the recollections of Greece and Rome are strangely enough mixed up with chivalric notions and legends of fairyland. La Guerre de Troie, by Benoit de St. More; the Alexandre by Lambert li Cors and Alexandre of Paris; the Médée, and the Ulysse by Raymond du Bosquet, are fair examples of this class. Almost contemporaneous with the chansons de geste, and related to them as comedy or farce is to tragedy, sprung up the fabliaux, short, humorous, satirical, poetic tales, a species of literature which obtained its highest perfection and greatest popularity in France. One of the most celebrated of fabliaux writers is Rutebeuf, a contemporary of St. Louis. But by far the most notable production of this nature is the Roman de Renard, the composition of different hands and even of different ages. This satiric epopee throws an air of ridicule over all classes and institutions of the time, king and priest, knight and judge, court and cloister, tourney and pil-

grimage. The spirit of the poem is the negation of that of chivalry, the vital principle of the Middle Ages. The progress of prose was slower than that of poetry. The earliest specimens are furnished by the monkish chroniclers, the most noteworthy being the 'Chroniques de France selon qu'elles sont conservées à St. Dénis.' It was, however, the genius of a layman that made history the rival of poetry, and the 'Histoire de la Conquête de Constantinople' (1302), by Villehardouin, an eye-witness, may be regarded as the first example of genuine French historical literature. This was followed by the Mémoires, in which Joinville (1223-1317) tells with winning naïveté the heroic deeds and private virtues of the good king Louis IX.; by the Chroniques de Froissart (1337-1410), which present the most animated pictures of society and manners of that period of war and gallant enterprise. By the Mémoires of Philippe de Commines (1445-1509) we are introduced to Louis XI. and his contemporaries; and we have striking evidence that the chivalrous poetic spirit of the Middle Ages had now fairly given way to shameless trickery and deep cunning. The race of the trouvères may be said to have ended with Charles, Duke of Orleans (1391-1465), whose graceful gallantry finds a strong contrast in the easy, unblushing impudence of Villon (1431-1500). The revival of classic learning and the reformation of religion exercised a powerful influence on the French literature of the 16th century. Its principal characteristics being freedom of thought and variety of style, writers cannot be judged by a single standard. In originality Rabelais (1483-1553) and Montaigne (1533-92) hold the first rank. The former was a profound scholar, physician, and philosopher, yet contented himself with the renown of a profane humorist. His 'Vie de Gargantua et de Pantagruel' is filled with strange tales, wild notions, and gross buffooneries, good sense, sound philosophy, and keen reasoning. As learned, as witty, and as skeptical as Rabelais, but wanting his coarseness, Montaigne lived a quiet, easy life, while France was being torn by civil war; writing his charming Essais, ridiculing the bigotry of the Catholic and the Protestant, the enthusiasm of the soldier, the trickery and pedantry of the judge; inclined to laugh at human imperfections rather as weaknesses than to storm at them as vices. These essays are a series of free and familiar disquisitions on every subject, and are one of the standards of French literature. Meanwhile the Reformation had been defended by Calvin (1509-64) in his 'L'Institution de la Religion Chrétienne,' a production which afforded convincing evidence that French prose had now acquired strength and gravity to become a fit vehicle of religious expression. Later in the century the admirable pamphlet, the 'Satire Ménippée,' and the speeches of Chancellor L'Hôpital, proved it to be flexible enough for political purposes. Amyot (1513-93) had invested it with new graces by happily blending French and Grecian beauties in his translation of Plutarch's 'Lives'; its capacity for lighter themes had been previously demonstrated by the Heptameron of Queen Margaret of Navarre (1492-1549). In poetry this period was less successful. Clement Marot (1495-1544) had indeed exhibited grace, elegance, and wit in his epistles, epigrams, and elegies; Ronsard (1524-85) attempted to invest French verse with that dignity and variety which he admired in the Greek metres, but his violent introduction of foreign forms and elements into the vernacular obtained scant success. The Clèopatre of Jodelle (1532-73) may be considered as the first drama of importance placed on the French stage. In the beginning of the next century the simplicity and ease of the verse of Regnier (1573-1613), and the correct and pure but somewhat cold and formal style of Malherbe (1556-1628), paved the way for the masters of the succeeding generation. Balzac (1597-1654) devoted his attention to the improvement of prose, his epistles especially being valuable at the time as models of harmonious rhetoric. Such were also the letters of his friend Voiture (1598-1648), affected and frivolous as they often are. Both were great favorites at the Hôtel de Rambouillet, the headquarters of French euphuism and of the Précieuses. Out of another of these social reunions, which were more of the nature of literary clubs, Richelieu founded the French Academy (1635); but it was outside all such coteries that France was to find the great poet who was to usher in the glories of her Augustan age. The drama was represented by Racine (1639-99) and by Molière (1639-93). Under the absolute sway of the Grand Monarque philosophy became orthodox under the guidance of Malebranche (1631-1715), Bossuet (1627-1704), and Fénelon (1656-1715). By the two last-mentioned writers, and by Bourdaloue (1632-1704), Massillon (1663-1742), and the Protestant divines Claude (1618-97) and Saurin (1677-1730), sacred eloquence was carried to a high state of perfection. The more important didactic prose writings of the age are the cynical 'Maximes' of La Rochefoucauld (1613-80), the 'Caractères' of La Bruyère (1639-99), and the 'Lettres and Discours' of St. Evremond (1613-1703). In the inimitable letters of Madame de Sévigné (1627-96) to her daughter and friends we have a lively and complete picture of the age, the writers of which had generally conformed to the manners, taste, and religion professed by the court. Before we fairly reach the philosophic era we meet with the names of Le Sage (1668-1747), to whom we are indebted for the *chefs d'œuvre* in novel-writing, 'Gil Blas' and the 'Diable Boiteux.'

The 17th century may be said to be fully represented by one man, Francois Marie Arouet de Voltaire (1694-1778). He claims notice as an epic, lyrical, and comic poet, as a tragic and comic dramatist, as a historian, novelist, and philosopher. It cannot be said that he excelled in the highest walks of literature; France could no more boast of a great epic poem after the 'Henriade' was written than she could before it; his tragedies are cold and formal, abounding in philosophical disquisitions; his histories are brilliant, but inaccurate. But his fund of common sense, his keen wit, his persistency, and his appreciation of the tendency of the age, made him be looked upon as chief of the republic of letters for more than half a century. His more important works are: 'Zaïre'; 'Mérope'; 'Alzire'; and 'Tancrède' (tragedy); 'Henriade' (epic); 'Dictionnaire Philosophique'; 'Charles XII.'; 'Siècle de Louis XIV.' (histories); 'Candide' (novel), etc. Next to him in immediate influence on the age stands Jean Jacques Rousseau (1712-78), whose fiery eloquence has

never been surpassed. In his 'Emile' he draws a visionary plan of education; his 'Nouvelle Heloise' is a novel in which love and paradox are strangely blended together; while his 'Confessions' excite a mingled feeling of sympathy and disgust. These two great men had each his school of disciples, who were the foremost actors in the Revolution. Buffon (1707–88) occupied a less agitated sphere, devoting his powerful intellect to the study of nature; his great 'Histoire Naturelle' is a monument which time can scarcely injure. Montesquieu (1689–1755), a writer of unusual scope of mind, combining a masculine vigor with great brilliancy of style, commenced his career with his 'Lettres Persanes', a satire on French manners, government, and even religion. Some tragedies by Joseph Chénier (1784–1811), founded on the classic models, a few light comedies and novels of little note, are the only representatives of literay activity, until we come upon the names of Châteaubriand (1768–1848) and Madame de Staël (1766–1817). The former, in his 'Génie du Christianisme' and his 'Martyrs,' and the latter in her 'Allemagne,' 'Delphine,' and 'Corinne,' combated the skeptical spirit of the age of Voltaire; and its political creed was attacked by Joseph de Maistre (1754–1821), and De Bonald (1753–1840). A more moderate politician and philosophical writer on sociology and religion is found in Benjamin Constant (1767–1830). Later on in the 19th century the influence of Goethe, Schiller, Shakespeare, Scott, and Byron began to be felt. Such was part of the creed of many of the most gifted of the younger men of letters in France, and a new school, called the romantic, sprung up, headed by Victor Hugo (1802–85), who promulgated the new theories in the preface to his drama of 'Cromwell,' and carried them into practice in numerous poems and novels ('Notre Dame de Paris,' 'Les Misérables,' 'Les Travailleurs de la Mer,' etc.). The most notable of his associates were Alfred de Vigny (1779–1863), calm, elegant, and somewhat too refined, author of a volume of 'Poëmes antiques et modernes,' of a translation of 'Othello,' and of a novel, 'Cinq Mars,' by which he is best known to English readers; the capricious Alfred de Musset (1810–57), at once the Ariel and Caliban of modern French literature, equally at home in the domains of poetry, drama, and romance, and whose favorite hero is a French copy of Byron's 'Corsair,' 'Lara,' or 'Don Juan'; Sainte-Beuve (1804–69), who published several volumes of poetry ('Consolations,' 'Pensées d'Août,' etc.), but now chiefly famous for his 'Causeries du Lundi' and other works of a literary-historical nature, in which he has proved himself to the satisfaction of numerous authorities the best literary critic France has ever possessed, and Alexandre Dumas the elder, who opened his career with a historical drama, 'Henry III.,' which was quickly followed by 'Charles VII.,' 'Antony,' 'Teresa,' etc., but who is best known to the most of English readers by his novels, 'Monte Cristo,' 'Les Trois Mousquétaires,' 'Vingt Ans Après,' etc. A reactionary movement was attempted, led by Ponsard (1814–67) and Emile Augier (1820–89). Casimir Delavigne (1793–1843) has attempted to combine the classic and romantic schools; and Lamartine (1790–1869) is more than half a romanticist by sentiment and style. Béranger (1780–1857), the greatest of French song-writers, may be considered as belonging to neither of the two schools, though he was ranged on the classicist side. The 25 volumes of light, sparkling comedies and vaudevilles, by the indefatigable librettist Eugène Scribe, can scarcely be claimed by any of the rival parties. After the heat of the struggle was over, which was chiefly carried on in the region of the drama, the novels of George Sand (Madame Dudevant, 1804–76) began to attract attention. Her 'Indiana,' 'Lélia,' 'Jacques,' 'André,' 'Consuelo,' 'La Petite Fadette,' 'La Mare au Diable,' etc., have gained her the reputation of possessing the finest style of any writer of the age. Balzac (1799–1850), by several critics considered the greatest of French novelists, lays bare the vices of modern society in his 'Eugénie Grandet,' 'Le Père Goriot,' 'Scènes de la Vie Privée,' etc. Low life in Paris was vividly depicted by Eugène Sue (1804–57) in the 'Mystères de Paris,' 'Martin, 'L'Enfant trouvé,' etc. The charming and pure tales of 'Picciola,' by Saintine (1798–1865), and 'Colomba,' by Prosper Mérimée (1803–70), are especially worthy of notice. Equally healthy in tone are the novels of Emile Souvestre (1806–54), and the admirable stories of the two novelists, conjoined in work as in name,— Erckmann-Chatrian (1822–99; 1826–90). A new school, styled the realistic, has had among its representatives the younger Dumas (1824–95), novelist and dramatist; Victorien Sardou (b. 1831), dramatist; Octave Feuillet (1812–90), Ernest Feydeau (1821–73); Henri Murger (1822–61), Gustave Flaubert (1821–80), and Edmond About (1828–85). Some of the most delicate of social problems are treated in them with candor, if with little delicacy. Still more recently a group of writers has arisen who have striven to outdo the most realistic of their predecessors in depicting scenes of low life. The chiefs of this school are Emile Zola (1840–1902), Alphonse Daudet (1840–97), Emile Gaboriau (1835–73), Adolphe Belot (1829–90), Victor Cherbuliez (1829–99), Paul Bourget (b. 1852), the brothers Edmond and Jules de Goncourt (1822–96; 1830–70), Guy de Maupassant (1850–93), etc. Among recent poets we may mention Théophile Gautier (1811–72), also known as a novelist; Leconte de Lisle (1818–94); Charles Baudelaire (1821–67); Sully-Prudhomme (b. 1839); François Coppée (b. 1842); Paul Verlaine (1844–96); Anatole France (b. 1844), also a well-known critic; Paul Déroulède (b. 1846); and J. Richepin (b. 1849). Other novelists not mentioned above are the following: Jules Sandeau (1811–83); Theuriet (b. 1833); Jules Claretie (1840), also known as critic and poet; G. Ohnet (b. 1848); Gyp, the *nom de guerre* of Countess de Martel de Janville (b. 1850); Louis M. J. Viaud, better known as Pierre Loti (b. 1850); and Marcel Prévost (b. 1862). If the preceding century was the philosophic age *par excellence*, the 19th may be said to be the historical. The following are the chief writers in other departments and their principal works: Louis Blanc (1813–82), 'Histoire de Dix Ans,' 'Histoire de la Révolution Française'; Guizot (1787–1874), 'Mémoires relatifs à l'Histoire de France,' 'Histoire de la Révolution d'Angleterre'; Michaud (1767–1839), 'Histoire de Croisades'; Michelet (1791–1874), 'Histoire de France'; Mignet (1796–1884).

'Histoire de la Révolution Française'; Sismondi (1773–1842), 'Républiques Italiennes du Moyen Age'; Amédée Thierry (1787–1873), 'Histoire des Gaulois'; Augustin Thierry (1795–1856), 'Conquète de l'Angleterre par les Normands,' 'Le Tiers Etat'; Thiers (1797–1877), 'Histoire de la Révolution Française,' 'Histoire du Consulat et de l'Empire.' Literary historians: J. J. Ampère (1800–64), 'Histoire littéraire de France avant le XII. Siècle,' 'Littérature Française au Moyen Age'; Littré (1801–81), 'Histoire de la Langue Française,' 'Comte et la Philosophie positive'; Sainte-Beuve (1804–69), 'Causeries du Lundi,' 'Portraits Contemporains'; Taine (1828–93), 'Histoire de la Littérature Anglaise,' 'Les Philosophes Français du XIX. Siècle'; Vinet (1797–1847), 'Blaise Pascal,' 'Moralistes des XVI. et XVII. Siècles. Philosophy is represented by Auguste Comte (1798–1857), 'Cours de Philosophie positive'; Victor Cousin (1792–1867), 'Le Vrai, le Beau, et le Bien,' 'Histoire de la Philosophie'; Jouffroy (1796–1842), 'Cours de Droit Naturel,' 'Cours d'Esthétique'; Lamennais (1782–1854), 'Esquisse d'une Philosophie'; Montalembert (1810–70), 'Du Vandalisme et du Catholicisme dans l'Art'; Quinet (1803–75), 'Le Génie des Religions,' 'Le Christianisme et la Révolution'; Rémusat (1797–1875), 'Essais de Philosophie,' 'Philosophie Religieuse'; Renan (1823–92), 'Histoire des Langues Sémitiques,' 'Vie de Jésus.' Among the writers on political economy and sociology are Bastiat (1801–50), Chevalier (1806–79), Prévost Paradol (1829–70), Tocqueville (1805–59), Jules Simon (1814–96), etc. We can simply mention the names of the principal scientific writers: Etienne Geoffroy St. Hilaire and his son Isidore, Cuvier, Jussieu, in natural science; Gay-Lussac, Bichat, Magendie, in chemistry and medicine; and Lagrange, Laplace, and Arago in mathematics. Writers of travels, etc., are Burnouf, Champollion, Father Huc, and others. Of essayists and literary and art critics Alphonse Karr, Emile Girardin, Jules Janin, Fétis, Villemessant, Théophile Gautier, and J. Lemaitre are among the best known. See ACADEMY, FRENCH; DUMAS; HUGO, VICTOR; VOLTAIRE.

French Architecture.—The earliest specimens of architecture in France belong to the Gallo-Romanic period. The Maison Carrée, a Corinthian temple in Nimes, is one of the best preserved and most interesting structures of that age. It is evident from what is still preserved of the ecclesiastical and other buildings that the forms of Greek art adopted by the Romans were closely imitated; and even up till the 11th century the construction of all edifices of importance was entrusted to Italian architects trained in the classic schools. Then the Gothic style arose, and carried all before it. The architectural art was cultivated by the ecclesiastics, and many buildings of extraordinary merit owe their origin to some monks, so piously humble that they have left no trace of their names. Some names have, however, come down to us. Fulbert, of Chartres, planned the cathedral of that town, and directed for a time the construction (1020); the abbey church of St. Dénis was built from the plans of the minister Suger. The cathedral of Amiens was commenced in 1220 by Robert de Luzarche, and continued by Thomas and Renaud de Cormont. About the middle of the 13th century there were three architects of great fame in France,—Jean de Chelles, who built the lateral portico in the south side of the cathedral of Notre-Dame, at Paris; Pierre de Montereau, who planned the old Holy Chapel of Vincennes; and Eudes de Montreuil, to whom Paris was indebted for several imposing churches now destroyed. Covey and La Bergier rebuilt the ancient cathedral at Rheims, which had been destroyed by a fire. Jean Ravy, sculptor and architect, employed his double talent to complete the cathedral of Notre-Dame (1351). The Gothic style began to lose ground about the end of the 15th century; and under the influence of the southern artists introduced into France by Francis I. Italian architecture obtained firm footing. The most celebrated French architects of that period were Lescot, Delorme, and Jean Bullant. Under the regency of Marie de Medicis flourished Desbrosses, who planned the Luxembourg Palace. The age of Louis XIV. was favorable to this art, and we meet with notable names — Perrault, Bruant, and Mansard, who built the Hôtel des Invalides. The palace of Versailles is the work of Mansard alone. The principal architects of the 18th century are — Gabriel, who designed the square known as the Place de la Concorde; Oppenor, who designed the greater part of the Palais Royal; G. de Boffrand, De Wailly, Lemaire, D'Ivry, Soufflot, the architect of the Panthéon and the Ecole de Droit; Antoine, Moreau, Descoutures, and Desmaisons, the joint authors of the Palais de Justice; Rousseau, who planned the Palace of the Legion of Honor, now burned down; Louis, who built the Théâtre Français; Chalgrin, whose chief work is the Collège de France, etc. Under the first empire the Bourse was erected by Brongniart, the Madeleine by Vignon and Huvet, the Arc de Triomphe du Carrousel and one of the wings of the Louvre by Fontaine and Percier, the Corps Législatif by Poyet. Among the recent architects of most note are Garnier, who erected the new opera house; Visconti, who completed the Louvre; Baltard, who planned the Halles; Lefuel, who reconstructed the Tuileries; Espérandieu, Viollet-le-Duc, Gau, Blouet, Duc, the architect of the façade of the Palais de Justice, etc. See ARCHITECTURE.

Painting and Sculpture.— France, in the reign of Charlemagne, and subsequently, had numerous miniature and enamel painters, but can be hardly said to have had a school of painting of its own until the 16th century. With the exception of the Clouets (father, son, and grandson) and Jean Cousin, who owed little to foreign masters, the older French painters either studied in Italy or were mere imitators of Italian painters; while many Italians were either temporary or permanent residents in France. Among these were Leonardo da Vinci, Andrea del Sarto, Rosso, and Primaticcio, all of whom were invited by Francis I. The influence of Rosso and Primaticcio was considerable. Commissioned to decorate the Palace of Fontainebleau, they employed many Italian and French artists as assistants, on whom they imposed their ideas, manner, and style, and this created a distinct school known as that of Fontainebleau. An independent French style was formed by Simon Vouet (1582–1641), who was regarded as the master and model of the succeeding generation of French artists. Nicolas Poussin (1594–1665), stamped a character on

the art of his country which may be said to have lasted almost to our own days. Claude Gelée (1600–82), better known as Claude Lorraine, is of all landscape-painters the one best able to express the poetry of nature. The most celebrated of Vouet's disciples were Eustache Lesueur (1617–55), and Charles Lebrun (1619–90), court painter to Louis XIV., and one of the founders of the Academy of Painting and Sculpture at Paris, and the French Academy at Rome. Pierre Mignard (1610–95), another pupil in the same school, was justly esteemed for the nobleness of his style and the delicate grace of his execution. The *fêtes galantes* of the nobility under the regency of Philippe d'Orléans were represented with piquant grace by Antoine Watteau (1684–1721). His exquisite finish, the poetic charm with which he transferred to his canvas the follies of the regency, have gained for him a fame which suffers somewhat from the attack of the higher critics, who charge him and his imitators with having degraded French art to its lowest pitch. In opposition to this school rose another, inspired with purer and healthier ideals: Pierre and Vien, historical painters; Chardin; and greater than all, J. B. Greuze (1725–1805), who represented the scenes of everyday life; and Varnet, painter of landscape and sea pieces. It was, however, painfully evident that art was steadily deteriorating. It owes its resuscitation to the mental excitement of the Revolution; but the form which it assumed was due to the genius and energy of Jacques Louis David (1748–1825), who tried to inculcate elevated sentiments on his disciples, and gain the sympathy of the French school for what was truly noble, grand, and heroic. Among the most distinguished of his pupils are Gérard, Gros, Drouais, Granet, and Ingres. A reaction against this classic school, as it was called, was headed by Géricault, Delacroix, Delaroche, Scheffer, Vernet, and Descamps. Among the eminent French contemporary artists we may mention Rosa Bonheur, an animal painter; Courbet, the leader of a new school called the realistic; Gustave Doré, Cabanel, Yvon, Bin, historical painters; Gérôme, Comte, Hector Leroux, G. Boulanger, Lévey, Bréton, Millet, Hébert, as genre painters; Corot, Rousseau, D'Aubigny, André, Noël, and Barry as landscape and marine painters; and Chaplin, Henner, Mademoiselle Jacquemart, and Henriette Browne, as portraitists.

The first essays of the French sculptors were little else than imitations of the Byzantine school, and later of the Italian. It was not until Jean Goujon (1515–72) had produced his 'Diana' that France could boast of an original sculptor. His most remarkable work is the 'Fontaine des Innocents' at Paris. Germain Pilon (1516–90), Jean Cousin (about 1500–90), and Barthélemy Prieur (d. 1611) were the ablest of his contemporaries. Jean de Bologne (1524–1608), though a Frenchman by birth, may be looked upon as an Italian from his long residence in Italy and his training under Michelangelo. François Anguier (1604–69) executed the beautiful tomb of the Duke of Montmorency in the church of St. Mary at Moulins, and along with his brother Michel the statues and reliefs of the Porte St. Dénis. Girardon (1628–1715), pupil of the former, was the favorite sculptor of Louis XIV., and executed a great number of statues for Versailles, Trianon, and other royal residences. A much superior artist, however, was Pierre Puget (1622–94), who, unassisted by any master, gained for himself deservedly the title of the French Michelangelo. He is undoubtedly one of the greatest sculptors of modern times. The art was practised with more or less success down to the 18th century by Pierre Legros, the brothers Coustou, Bouchardon, L. Adam Lemoyne, Bosio, Stouf, and Pigalle. The revolution which took place in painting under the influence of David extended itself to sculpture, but the new school which arose, in their zeal for reform, soon fell into conventionality and affectation. The downward progress of the art was, however, arrested by David of Angers (1789–1856), Pradier (1792–1852), and Rude (1784–1858). Among the more distinguished of modern French sculptors may be mentioned Barye, Ramey, Jouffroy, Perraud, Carpeaux, Caïn, Guillaume, Gruyère, Leharivel-Durocher, Dubois, Falguier, Aizelin, Chapu, Rodin, etc. See ART; SCULPTURE.

Bibliography.—Adams, 'Democracy and Monarchy in France' (1884); Bodley, 'France' (1898); Block, 'French Dictionary' (1878); Bourgeois, 'France Under Louis XIV.' (1889); Cleveland, 'Constitution of France' (1890); Coubertin, 'The Evolution of France Under the Third Republic' (1897); Currier, 'Laws of France' (1875); Duruy, 'Histoire de France' (1889); Elliot, 'Old Court Life in France' (1892); Erckmann-Chatrian, 'Invasion of France, 1814' (1885); Fleury, 'Histoire de France' (1891); Guerber, 'Empresses of France' (1892); Guizot, 'Histoire de France' (1870); Hassell, 'The French People' (1892); Kitchin, 'History of France to 1793' (1882); Lacroix, 'Mineralogy of France and Her Colonies' (1894); Martin, 'Histoire de France' (1860); Sorel, 'Lectures Historique' (1894); Sybel, 'History of the French Revolution' (1869); Thiers, 'History of the French Revolution' (1881); Von Holst, 'The French Revolution' (1894); White, 'History of France' (1890). See also works on Napoleon, Franco-Prussian War, Joan d'Arc, etc.

France, Isle of. See MAURITIUS.

Francesca, Piero Della, pē-ā'rō dĕl lä frän-chĕs'kä, Italian painter: b. Borgo San Sepolcro, Italy, 1398; d. 1484. His early work has perished and Raphael painted out the frescoes he did for Nicolas V. in the Vatican. Some very fine work of his still remains in the pictures he executed, after his return from Rome, at Borgo San Sepolcro, Arezzo, and Loreto. Losing his eyesight at 60 he devoted himself to the study of mathematics, and his principal claim to fame lies in the fact that he was the first of the Italian school to formulate the principles of linear perspective, to study the anatomy of the nude, to employ lay figures, modeled in clay, and draped with costumes folded wet.

Francesca da Rimini. See DA RIMINI, FRANCESCA.

Francesco di Paula, frän-chĕs'kō dē pō'lä, or **Saint Francis of Paola,** Italian monk: b. Paula or Paola, Calabria, 1416; d. Plessis-les-Tours 2 April 1507. At the age of 13 he was the inmate of a Franciscan convent; and at 19 he retired to a cave where he inflicted on himself every species of self-mortification. The fame of his piety having attracted to his cell sev-

eral emulators of his austere life, he obtained permission to erect a convent, and the new community received from Pope Sixtus IV. the title of the Hermits of St. Francis of Assisi; but the title was changed by Alexander VI. to Minim-Hermits of St. Francis of Paola. The founder established numerous communities in Italy, Sicily, France, Spain, and Germany, but the Minims were never settled in Great Britain or Ireland. To the usual conventual vows, Francesco added one of the most rigorous abstinence — flesh, eggs, cheese, and milk being strictly forbidden the entire year, except in illness. Popular report having attributed to Francesco several wonderful cures, Louis XI. of France, being ill, summoned him to his presence. Francesco was received with the highest honor, and attended the king on his death bed. Charles VIII. and Louis XII. detained him, with his fraternity, in France. Charles consulted him on all affairs of importance, and other princes also gave the Minims proofs of their favor. In Spain they were called the Brothers of Victory, in commemoration of the deliverance of Malaga from the Moors, which had been predicted by Francis. Twelve years after his death he was canonized by Leo X., and the Roman Catholic Church celebrates his festival on 2 April.

Franchetti, frän-chĕt'tē, Baron **Alberto,** Italian composer: b. Turin 1860. He was a pupil of Coccon and Magi, studied at Dresden and Munich, and in 1888 produced his most successful opera 'Asraele.' Other operas and works of less importance prove him one of the best representatives of modern Italian music.

Fran'chise, in law, a right belonging to a subject of exercising a branch of the sovereign or government prerogative, either in virtue of a grant conferring such right, or by prescription, which always presupposes such a grant. The corporate franchise, that is, the right of being incorporated, and of holding fairs, ferries, etc., are among the most important franchises, which are, however, almost infinite. In politics it is the right of voting upon proposed legislative measures, where such measures are accepted or rejected by the people generally; or for representatives to a legislative assembly (the parliamentary franchise) or to a municipal body.

Francia, frän'chä, easel name of Francesco di Marco di Giacomo Raibolini, Italian painter: b. Bologna 1456; d. there 5 Jan. 1517. He assumed his name of Francia from that of the goldsmith under whom he began his art studies. He was a pupil in painting of the Ferrarese, Lorenzo Costa, and shows the influence of his master's style. He painted portraits and history, his greatest work being the Bentivoglis altarpiece, in the Church of San Giacomo Maggiore, Bologna.

Francia, José Gaspar Tomas Rodriguez da, hō-sā' gäs'pär tō'mäs rō-drē'gēs frän'-sē-ä, Paraguayan dictator: b. Asunçion 1756; d. there 20 Sept. 1840. He was sent to the University of Cordova, with a view to entering the Church; but his plans underwent a change, and on his return to his native town with the degree of doctor of laws, he began his public career as a barrister. His high reputation for learning, but still more for honesty and independence, procured him an extensive practice; and he devoted himself to legal pursuits for 30 years. In 1811, when Paraguay threw off the Spanish yoke, he became secretary of the junta appointed by congress. In 1814 he was appointed dictator for three years, and in 1817 he was continued in authority for life. No sooner had he reached the goal for which he had been striving than he began to display the utmost tryanny in his administration. He was kindly disposed toward foreigners, till they excited his jealousy by the culture of Paraguay tea, of which he made a state monopoly. After everything had been placed completely at his beck he seemed, in 1824, disposed to return to milder courses, but a new attack of his constitutional malady led him again to a renewal of his tryannical proceedings; but as Paraguay had improved under his government, and the inhabitants had become reconciled to his tyranny, he was able to continue his system till his death.

Franciabigio, frän-chä-bē'jō (the easel name of Francesco di Cristofano Bigi), Italian painter: b. Florence 1482; d. there 24 Jan. 1525. He was a pupil of Albertinelli, where he met and made a friend of Andrea del Sarto. The two artists painted in collaboration the frescoes in the Santa Annunziata Church at Florence. In these paintings the influence of del Sarto is very apparent, as well as in the 'Last Supper,' which Franciabigio painted in the refectory of San Giovanni, and the oil painting at Dresden, 'David and Bathsheba.' He has left many excellent portraits, one of which is in the Berlin Museum.

Fran'cillon, Robert Edward, English novelist: b. Gloucester, England, 25 March 1841. He was educated at Trinity Hall, Cambridge. He was admitted to the bar in 1864 and was on the staff of the London *Globe* 1872–94. His novels are: 'Earl's Dene'; 'Pearl and Emerald' (1872); 'Olympia'; 'Strange Waters'; 'Zelda's Fortune'; 'A Real Queen'; 'Queen Cophetua' (1880); 'Under Slieve-Ban' (1881); 'King or Knave' (1888); 'A Dog and his Shadow'; 'Jack Doyle's Daughter'; 'Ropes of Sand'; 'Gods and Heroes'; etc.

Francis I., king of France: b. Cognac, France, 12 Sept. 1494; d. Rambouillet 31 March 1547. He succeeded to the throne in 1515, on the death of Louis XII., who died without male issue. As grandson of Valentino of Milan, he put himself at the head of an army to assert his right over the Milanese. The Swiss, who opposed him in his entry into the duchy, were defeated at Marignano (or Melegnano), and Milan fell immediately after this victory. After a short war with England, the famous interview between Henry VIII. and Francis took place, in 1520, in Flanders, which, from the magnificence displayed on the occasion, was called The Field of the Cloth of Gold (q.v.). In the same year, Charles V. of Spain having inherited the empire after the death of Maximilian, Francis laid claim to the imperial dignity and declared war against his rival. In this struggle, however, he met with nothing but reverses. After the defeat of Marshal Lautrec at Bicoca, in 1522, the retreat of Bonnivet, and Bayard's death, Francis was himself, in 1525, beaten at Pavia, and taken prisoner. The fight had been a fierce one, and the king wrote to his mother, «All is lost, except honor.» Led captive into

Spain, he recovered his liberty only at the cost of an onerous treaty, signed at Madrid in 1526; but which Francis subsequently declared null and void. He immediately recommenced war in Italy, met with fresh defeats, and concluded a second treaty at Cambrai in 1529. He once more invaded Italy, in 1536, and, after various successes, consented to a definite arrangement at Crespi, in 1544, by which the French were excluded from Italy, though Milan was given to the Duke of Orleans, the second son of Francis. Francis was a friend to arts and literature, which flourished during his reign; and he was called the "Father of Letters." Justice, also, began to be better administered in his reign. He founded the Royal College of France, the Royal Library, and built several palaces. He was succeeded by his son, Henry II.

Francis II., king of France, son of Henry II. and Catharine of Medici: b. Fontainebleau 19 Jan. 1544; d. Orleans 5 Dec. 1560. He ascended the throne on the death of his father, 10 July 1559. The year previous he had married Mary Stuart, only child of James V., king of Scotland. During his short reign of 17 months were sown the seeds of those evils which afterward desolated France. The uncles of his wife, Francis, Duke of Guise, and the Cardinal of Lorraine, held the reins of government. The latter stood at the head of the clergy, and had charge of the finances. The former had the direction of military affairs; and both used their power solely as a means of gratifying their pride and avarice. Antony of Bourbon, king of Navarre, and his brother Louis, Prince of Condé, provoked that two strangers should govern the kingdom while the princes of the blood were removed from the administration, united with the Calvinists to overthrow the power of the Guises, the protectors of the Catholics. Ambition was the cause of the quarrel, religion the pretext, and the conspiracy of Amboise formed among the French nobility, especially the Calvinists, with the object of removing the king from the influence of the Guises, the first symptom of the civil war. The war broke out in March 1560. In December of the same year Francis died, leaving the kingdom loaded with debt, and a prey to all the miseries of civil war.

Francis I., emperor of Germany: b. 8 Dec. 1708; d. Innspruck 18 Aug. 1765. He was the son of Leopold, Duke of Lorraine. He inherited this duchy from his father in 1729, and six years afterward exchanged it for that of Tuscany, which the death of the last of the Medicis had rendered vacant. In 1736 he married Maria Theresa, the daughter of the Emperor Charles VI. On the death of the latter, he disputed the imperial dignity with the elector of Bavaria, whom France supported, and who took the name of Charles VII.; he was, however, defeated, and Francis reigned peaceably for 20 years. He had 16 children, among whom were Joseph II., who succeeded him, and the unfortunate Marie Antoinette. See MARIA THERESA.

Francis II., emperor of Germany, and **I.** of Austria: b. Florence, Italy, 12 Feb. 1768; d. Vienna 2 March 1835. He succeeded his father, Leopold II., in 1792, as emperor of Germany, king of Bohemia, Hungary, etc. At the very commencement of his reign, he had to sustain a war against France, in which he was defeated, and was, in 1797, obliged to sign the treaty of Campo Formio, which deprived him of the Netherlands and Lombardy. Another war taking place with the same power, he was not more fortunate than in the first, and was beaten at Marengo, and lost, by the Treaty of Lunéville, in 1801, all his possessions on the Rhine. In a third campaign, undertaken in 1805, the French were victorious over his armies at Elchingen, Ulm, and Austerlitz; and the Treaty of Presburg still further diminished his territory. Renouncing now the title of emperor of Germany, he took that of Austria, under the name of Francis I. He tried again the fate of battles in 1809; but the defeats of Eckmühl and Wagram led to the Peace of Schönbrunn, to cement which more strongly his daughter Maria Louisa was, in 1810, given to Napoleon I. Notwithstanding this alliance, however, he, in 1813, joined the coalition against his son-in-law and contributed considerably to his overthrow. The treaties of 1815 put him again in possession of the greater portion of his territory, and he reigned peaceably till his death.

Francis I., king of the Two Sicilies, son of Ferdinand I.: b. Naples 19 Aug. 1777; d. there 8 Dec. 1830. Twice during the lifetime of his father he carried on the government of the kingdom under the name of viceroy; first in 1812, when a constitution was granted to Sicily; and afterward in 1820, during the troubles which broke out in Naples and Palermo. He mounted the throne in 1825, and died 1830, without having achieved anything remarkable. He was succeeded by Ferdinand II.

Francis II. (Francesco d'Assisi Maria Leopold), king of the Two Sicilies: b. Naples 31 Jan. 1836; d. 27 Dec. 1894. He succeeded his father, Ferdinand II., in 1859, and attempted to carry out the monarch's policy. His dominions were invaded by Garibaldi in 1860 and Gaeta, his last stronghold, fell in 1861. Subsequently the deposed ruler lived in France in retirement, occasionally organizing abortive expeditions against the Italian kingdom.

Francis Joseph, Charles, emperor of Austria: b. Vienna 30 Aug. 1830. He became emperor 2 Dec. 1848, and found the empire shaken by internal dissensions; and his first step was to promise a free and constitutional government to the country. The course of events, however, compelled him to close the national assembly, and to assume absolute power. He centralized the governments of his heterogeneous nationalities at Vienna, and, aided by Herr Von Brück, inaugurated a series of fiscal and commercial reforms favorable to the interests of the middle classes. In 1853–4, the emperor endeavored, though in vain, to induce the Czar Nicholas to abandon his ambitious designs against Turkey, and further excited that autocrat's displeasure by refusing to assist Russia against the western powers, whose rulers also felt aggrieved because he resolved to remain neutral and declined to throw the weight of his name into their scale. The unwillingness of Austria to make common cause with the western powers has been severely punished, for had she joined the alliance against Russia in 1854, in all probability Louis Napoleon would not have crossed the Alps and dictated the Peace of Villafranca. It is, therefore, more than prob-

able that her reluctance to act against Russia in that war was the cause of her losing Lombardy three years later. At Solferino the emperor gave proof of bravery amounting almost to rashness. In April 1854 he married the Princess Elizabeth Amalie Eugenie, daughter of the Duke Maximilian Joseph, and cousin, on her mother's side, to the king of Bavaria. The plenipotentiaries of Austria, Prussia, and Denmark, assembled at Vienna to consider the terms of a peace, 26 July 1864, which was concluded 30 October. The convention of Gastein signed 14 Aug. 1865, transferring the government of Schleswig to Prussia, and that of Holstein to Austria, was a few days after confirmed by the emperor and the king of Prussia at Salzburg. The emperor issued an important manifesto to his people, 20 September, in which he expressed very conciliatory intentions toward the peoples of Hungary and Croatia. At the beginning of 1866, the armaments against Prussia commenced, and an imperial order was issued 6 May, placing the whole army on a war footing, and concentrating the army of the north on the frontiers of Bohemia. In 1867, the emperor put an end to the hostilities of Hungary by re-establishing the constitution of that country; and on 8 June, he was crowned at Budapest as king of Hungary, with extraordinary pomp. In December of the same year, a new constitution, one of the most liberal of continental Europe, framed by the Reichsrath, was approved by the emperor, and promulgated as the fundamental law of the empire. His only son, Rudolf, committed suicide in 1889, and the emperor's nephew, the Archduke Francis Ferdinand, is heir-presumptive. See AUSTRIA.

Francis, David Rowland, American politician: b. Richmond, Ky., 1 Oct. 1850. He was graduated from Washington University, St. Louis, 1870, entered business and in 1877 established the firm of of Francis Brothers, grain merchants, St. Louis. He was mayor of St. Louis 1885–9, governor of Missouri 1889–93, secretary of the interior under President Cleveland 1896–7, and became president of the Louisiana Purchase Centennial Exposition in 1901.

Francis, Joseph, American inventor: b. Boston, Mass., 12 March 1801; d. Cooperstown, N. Y., 10 May 1893. He was the inventor of a number of life-boats and life-cars which came into general use and by means of which 200 persons were saved when the British ship Ayrshire was wrecked on the New Jersey coast in 1850. It is estimated that in four years as many as 2,150 lives were saved.

Francis, M. E. See BLUNDELL, MRS. FRANCIS.

Francis, SIR **Philip,** British statesman: b. Dublin 22 Oct. 1740; d. London 23 Dec. 1818. He is the best accredited of the candidates for authorship of the 'Junius' letters. He entered the civil service, and was rapidly advanced, owing partly to his abilities and partly to personal influence curiously accordant with partialities shown in the 'Letters.' Suddenly raised to the lofty position of one of the resident India council appointed by Parliament to control those affairs, he went out to India; spent his time there in a furious contest for supremacy with Warren Hastings; was finally vanquished, but achieved a terrible revenge after his return to England, by inciting Hastings' impeachment and coaching Burke; entered Parliament, prepared many pamphlets and made many speeches of much ability and unfailing acrimony. The 'Letters' — savage assaults on the heads of the party in power, up to George III. himself — appeared in the 'Public Advertiser' of London from 1867 to 1772; ceasing with the dispersion of the party faction most liked by Francis, and a year before his great promotion and his departure from England. The case for his authorship is effectively put in Macaulay's 'Essay on Warren Hastings.' See JUNIUS.

Francis of Assisi, äs-se'ze, **Saint,** Italian founder of religious order: b. Assisi, Umbria, Italy, 1182; d. Assisi 4 Oct. 1226. St. Francis of Assisi is the founder of the Friars Minor, who are usually styled Franciscans (q.v.). His family name was Bernardone. At baptism he was called John. Whether it was because his father, who was a merchant, was at the time largely engaged in French trade, or because of the saint's own familiarity with the French language, the name Francis eventually superseded that of John. As a youth he was remarkable for his ardent piety and the spotless purity of his life, but is reproached with a worldly vanity in dress which his wealth enabled him to indulge in. A change of heart came over him in consequence of a year's confinement as a prisoner of war; a serious illness helping the transformation. He began to dispose of his property for the purpose of repairing dilapidated churches. Irritated by his extravagance his father treated him with the greatest cruelty; the trouble ending by the saint's abandonment of everything, even his worldly apparel, and he assumed the dress of a common laborer. His zeal for church restorations grew in intensity, and being no longer able to devote his own patrimony to the work he obtained the necessary means by begging; he himself laboring at the buildings with his own hands. His affection was lavished also on the poor and especially upon lepers. He lived in the extremest poverty, practised the greatest austerities, and for a time was looked upon as a madman. Distinguished and learned men, however, began to associate with him and follow his way of life. Though not a priest (and he never became one) he began to preach everywhere on the necessity of penance. As those were the days in which Barbarossa was raging against the Church, both religion and morality needed reformation, and the preacher was eagerly listened to by all classes. When the number of his followers increased, the desire to institute a new religious order developed, and for that purpose he betook himself to Rome, but Innocent III., then sovereign pontiff, treated the proposal with indignation. Francis persevered, and the request was granted. The new community, known first as the Preachers of Penance, increased with astonishing rapidity, and at the first general chapter more than 5,000 friars assembled; some from the humble classes of life, others already famous in Church and state. The foundation of the order coincided with the great Lateran Council, the spirit of which was against the formation of any new religious order. In spite of this, however, there seemed to be a tacit consent to allow the new movement to proceed. It was when Pope Honorius finally gave

the necessary authorization that Francis met the Spanish canon Dominic, who was in Rome to found his own Order of Preachers, commonly known as Dominicans (q.v.). The two saints met in church and instinctively recognized each other, becoming immediately most devoted friends. The visions and miracles reported of Francis are bewildering in their number and character. In the hope of martyrdom he made several attempts to preach the gospel to the Mohammedans. His prayer and austerities were continued, his ecstasies frequent, and while on Mt. Alverno he received on his person what are known as the *stigmata*, namely, bleeding wounds on the hands, feet, and side, corresponding to the marks on the crucified body of the Saviour. Wherever he went he was honored as a saint; and his preaching was irresistible in its pathetic and stirring appeals to repentance. The rule of life he laid down for his followers was based on the strictest poverty, that is, no property, and dependence on the alms of the faithful. This extreme rigor almost immediately brought dissension in the order. Parties were formed, and the Friar General Elias, who had been appointed by Francis, was its bitterest opponent, going so far as to leave the order and to side with Barbarossa, who was then in open warfare with the Church. Nevertheless, the friars continued to increase in number and to spread everywhere, preaching the gospel and carrying the faith into distant countries. Besides his order for men, he established another for women, commonly known as the Poor Clares, so called from Saint Clare, the first superior. There is still another section called the Third Order of Saint Francis, for men and women living in the world, who follow a mitigated and adapted form of the rule of the friars. All three have given a vast number of saints and scholars to the Church. Francis died at the age of 45, 19 years after the establishment of his order. The extreme beauty, simplicity, and amiability, and perhaps the poetry, of the saint's character, but especially his love of created nature, have had the effect in our own days of developing a singular cult for him on the part of many outside the Catholic Church. The movement was started by Paul Sabatier, a French Calvinist minister, and Franciscan societies for the study of the life of the saint and of everything connected with him have been established in several countries of Europe.

Bibliography.— Segur, 'Popular Life of Saint Francis'; Saint Bonaventure, 'Life of Saint Francis'; Thomas de Celano, 'Life of Saint Francis'; 'Franciscan Annals.'

THOMAS J. CAMPBELL, S.J.

Francis de Sales, sālz, Fr. säl, **Saint,** French prelate, founder of the Order of Visitation: b. of a noble Savoyard family, in the château of Sales, near Geneva, 21 Aug. 1567; d. Lyons 28 Dec. 1622. He was educated by the Jesuits at Paris, studied law at Padua, and having a strong bent to theology and a religious life, entered the Church. Earnest and successful as a preacher, he was sent in 1594 with his kinsman, Louis de Sales, to preach in the duchy of Chablais, and bring back, if possible, to the Roman Catholic Church the followers of Calvin. He had a large measure of success. His conferences with Théodore de Bèze, Calvin's successor, at Geneva, were, however, without result. He went to Paris in 1602, preached there with great success, and steadily refused the offers of dignities made by the French king. The same year he was appointed bishop of Geneva, and taking St. Charles Borromeo as his model, applied himself zealously to the reform of the diocese and its monasteries. He was disinterested and free from worldly ambition, and declined the offer of a cardinal's hat and the renewed invitations of the king of France. In 1610 he founded the Order of the Visitation, of which the first directress was his friend, Madame de Chantal. His best known works are the 'Introduction to a Devout Life,' which has been translated into many languages, and 'A Treatise on the Love of God.' He was canonized by Pope Alexander VII. in 1665. See 'Life' by Camus.

Francis Xavier, zăv'ĭ-ėr, Fr. ksăv-ē-ā, **Saint,** Spanish Jesuit missionary: b. Castle of Xavier, Navarre, 7 April 1506; d. Island of Sancian 2 Dec. 1552. Saint Francis Xavier was born in Spain, of one of the noblest families of the kingdom of Navarre. After the usual collegiate studies in his own country, he went to Paris for a course of philosophy in the University. In spite of his extreme youth, his extraordinary ability secured for him a professorship in the affiliated College of Beauvais. It was in Paris that he met the man who shaped his destinies, Ignatius of Loyola (q.v.). Abandoning his professorship, he took up the study of theology, practised the rudest austerities, bound himself to a life of evangelical poverty, chastity, and obedience, and with Ignatius and five other companions established what is known as the Society of Jesus.

The original purpose of this organization was to evangelize Christians living in the Mohammedan countries of the East. Failing in that, they offered themselves to the Pope and were employed by him in most responsible trusts in various parts of Europe, which, however, they combined with labor in pest houses, prisons, and among the abandoned poor. A demand coming from John III. of Portugal for 10 missionaries to evangelize the new Portuguese possessions in India, Francis Xavier was chosen, but went alone, invested, however, with the dignity of Apostolic Nuncio, a dignity which he sedulously kept out of sight.

The day after the command was given to go he left Rome for Lisbon, making the journey on foot, preaching and teaching on the way. In Portugal his influence was so instantaneous and so great that the king purposed to keep him in his dominions. But nevertheless Xavier set sail for the East, 7 April 1541, having refused even to see his own relatives before leaving. The journey meant more than a year of great sufferings, and he reached Goa only on 6 May 1542. The ignorance and immorality which prevailed there were deplorable and a complete and immediate revolution in conditions followed his arrival.

Then began his series of amazing apostolic journeys. They can only be appreciated by recalling the methods of travel of those days; the perilous character of the seas through which he continually sailed, and the savage or barbarous nature of the people he had to evangelize. From Goa he went around Cape Comorin and Ceylon,

then back to Goa again, then through every principality of Hindustan, off through the scattered islands of the coasts, until he reached the distant Moluccas; establishing missions everywhere, and managing all the complicated and multiplied works which necessarily resulted. The story of his life is simply a series of surprising evangelical conquests, bringing thousands to Christianity by the efficacy of his preaching, the prodigies he wrought, and the extraordinary sanctity of his life.

On 15 Aug. 1549 he reached Japan. He remained there only two years and four months, but succeeded in penetrating almost all the little kingdoms into which the country was then divided; breaking down the opposition of the Bonzes who were the chief enemies of the Gospel, winning vast numbers to the faith, and establishing his followers in the favor of both rulers and people. The sway which he exerted over the Japanese mind may be inferred from the reverence with which he is still regarded there. The thoroughness with which he and his successors taught Christianity is evidenced by the fact that 25,000 Catholics were found in Japan after three centuries of persecution. They had handed down the faith from father to son without any ecclesiastical ministrations.

To obtain laborers for this new field he returned to Goa in 1551. We then find him venturing on a new project, attempting to win China to Christianity. Its conversion he thought essential for the maintenance of the faith both of India and Japan; for the corrupting influences in both those places he considered to be largely due to their relationship with China. He never reached that country but died on the Island of Sancian, about six leagues from Canton, being only 46 years of age. This last fatal voyage had lasted nine months.

His entire apostolate in the East extended over only 10 years, but he is said to have planted the faith in 52 kingdoms, preached the Gospel through 9,000 miles of territory, and baptized more than 1,000,000 persons. Fifty years after his death Pope Paul V. by a bull, dated 25 Oct. 1605, declared him blessed, and, 16 years subsequently, Gregory XV. canonized him, but on account of the pontiff's death, which occurred just at that time, the bull of canonization was issued by Urban VIII. on 6 Aug. 1623. He is honored in the Church on 3 December and is usually styled "the Apostle of the Indies." The devotion to him is universal and countless churches are erected under his invocation. His relics are still preserved in Goa, and in 1850 the body was found to be incorrupt.

Bibliography.— Bartoli, 'Life of St. Francis Xavier'; Bouhours, 'Life of St. Francis Xavier'; Coleridge, 'Life and Letters'; B. N., 'History of the Society of Jesus'; Cretineau-Joly, 'History of the Society of Jesus.'

THOMAS J. CAMPBELL, S.J.

Francis'cans, the designation borne by the members of the three great religious orders founded in the 13th century by St. Francis of Assisi. The first of these orders is that of the Friars Minor, known as the Greyfriars, and in France as the Cordeliers. The second order is that of the Poor Clares, called in Italian *Povere Donne* (Poor Ladies), and in France the Clarisses. The third order is that of Penance, or Tertiaries.

1. Francis, keenly alive to the evils which in his day seemed to threaten the very existence of the Church and society, strove to counteract their baneful influence by establishing an order, the members of which were to observe the most absolute poverty, and to be devoted to the service of the Church. The goal which he aimed at was to reproduce the ideal of the divine life on earth, therefore neither he nor his were to possess anything temporal, but were to go about doing good and preaching to all the world the kingdom of heaven. A little band of disciples to the number of seven, aglow with enthusiasm, gathered around the saint, and the little chapel of Sta. Maria degli Angeli, near Assisi, which he called Portiuncula, "the little portion, or inheritance," was the place where the order was first planned. It was truly a humble origin, an insignificant beginning, but Francis had a presentiment of the future world-wide extension of his order. In 1210 he obtained from Innocent III. a verbal approbation of the rule he had drawn up for it. Forthwith it appeared how accurately he had gauged the wants of his age, for his order sprang at a bound into popular favor. So rapid was its growth that 10 years afterward at a chapter held near Assisi, more than 5,000 of his religious assembled, and not half a century had elapsed when they counted missionaries in every known country, as may be learned from a bull of Alexander IV. in 1258. In 1260, when a chapter presided over by St. Bonaventure was held at Narbonne, the order had 1,400 houses. At the dissolution of the monasteries in England there were 65 houses of Franciscans, and even in 1680, in spite of severe losses in Protestant countries, the order numbered 100,000 members. The order is ruled by a general minister, who, with his council or *definitorium,* resides in Rome. It is divided into provinces to govern which provincials are elected. Each province is composed of a certain number of houses or convents, whose superiors are termed guardians.

Owing to the absolute nature of the poverty prescribed by the second rule drawn up for the first order and approved by Honorius III. in 1223, some of St. Francis' immediate followers showed tendencies inimical to it even in the saint's lifetime. After his death these tendencies became more marked, and were covertly connived at and effectively encouraged by the second minister-general, Elias of Cortona. This was the rift in the lute which widened as time went on. Some zealous upholders of the purity of the rule, such as St. Anthony of Padua, Adam de Marisco, Cæsar of Spires, protested against all innovations, and labored strenuously to maintain intact their sacred inheritance, receiving the distinctive name of Cesarines, but eventually returning to the body of the order in 1256. Other reforms were initiated, such as that of Peter of Macerata, 1294; that of Philip of Majorca, 1308; that of John of Vallées, 1336; and others. They met with varying success, until in 1415 a final split took place, one section of the order adopting the mitigations which had been introduced in the matter of poverty, this being the bone of contention all through. They became known as the Conventuals, while the members of the other section were called Observants, as observing faithfully the Franciscan traditions. These latter still adhere strictly to the original austerity

of their rule. St. Bernardine of Sienna, St. John Capistran, and St. James de la Marcha were mainly instrumental in promoting the interests of the Observance. In 1517 Leo X. issued his famous bull, *Ite et vos in vineam meam*, decreeing that a general minister of the whole order was to be chosen from among the Observants, and that the Conventuals were to elect a master-general. The Observants, however, did not satisfy the zeal of some, and thus we find certain groups, such as the Reformati, originating in Italy; the Alcantarines, or those who follow the reform of St. Peter of Alcantara, in Spain; and the Recollects.

There were now the two great families of the first order, the Observants and the Conventuals, these latter being governed, as said above, by a master-general, and notwithstanding their dispensations in regard to poverty, they have always rendered important services to the Church. The great Pope Sixtus V. was himself a Conventual.

In 1525 there arose a third family, known as the Capuchins (q.v.).

The Franciscans did not devote themselves exclusively to the apostolic life. From the first they took an active and leading part in the study of Holy Scripture and in all the branches of sacred and secular learning. They have filled with honor the first chairs in the most celebrated universities. Such great names occur among them as Alexander of Hales, St. Bonaventure ("the Seraphic Doctor"), Blessed John Duns Scotus, called "the Subtle Doctor," who as defender of the Immaculate Conception became the leader of the Franciscan school, Francis Mayronis, and Nicholas de Lyre. In England during the centuries immediately preceding the Reformation, there were 67 friars professors at Oxford and 73 at Cambridge, among them being Adam de Marisco, Duns Scotus, Roger Bacon, the pioneer of the modern discoveries in the physical sciences. Thomas de Celano, who wrote 'Dies Iræ,' and Jacopone da Todi, author of 'Stabat Mater,' were Franciscans. Nuncios, legates, archbishops, 50 cardinals, and 5 popes have been chosen from among the Franciscans.

The relations of the Franciscans with America began with its very discovery. Father Juan Perez, guardian of the Franciscan monastery at La Rabida, the adviser and personal friend of Columbus, with several companions, accompanied the discoverer in 1493. The first convent was erected for them at what is now the city of Santo Domingo, on Haiti; another arose at La Vega, on the same island. Connected with these convents were the first schools in the western hemisphere.

Owing to the enthusiasm among the religious in Spain, and to the docility of the Indians, the order spread so rapidly in the West Indies that King Ferdinand found it advisable to issue a decree forbidding the erection of a new convent except at a distance of at least five leagues from one already existing. In 1505, only 13 years after the discovery, there was a sufficient number of convents to form a province, under the name of Holy Cross. The first diocese to be erected was Santo Domingo, in 1504; its first bishop was Father Juan de Padilla, a Franciscan.

After the Spaniards had set foot on the mainland, the king, ever anxious for the spiritual welfare of the aborigines, sent over a great number of friars under the leadership of Father Juan de Quevedo, who was appointed bishop of Darien, the first bishop on the American continent. The Franciscans entered Venezuela in 1508, Brazil in 1519; in 1535 they were able to form a province in Peru, whence were founded the missions farther south in the Andes and Pampas. Saint Francis Solanus, called the Apostle of Peru on account of his extraordinary missionary labors, evangelized these regions; he died at Lima in 1610.

In 1521, if not before, the first Franciscans came to Mexico. Together with 12 friars known as the Twelve Apostles of Mexico, there labored here from 1533 to 1572 the famous Brother Gante. He wrote a catechism in the Aztec language, erected over 100 churches, and with one companion frequently baptized 8,000 Indians in one day. Many schools were erected, in which often as many as 600 and 800 boys received an elementary education. Owing to their stainless lives, abstinences, and contempt for gold, the friars obtained marvelous results among the natives. In 1535 the 70 convents in Mexico were organized into a province. At the end of the 16th century there were three provinces; others have been formed since then, besides several missionary colleges, whence zealous missionaries set out to convert the natives to the north, notably in Florida, New Mexico, Arizona, Texas, and California.

Florida was the first of the States that beheld the Franciscan garb. Five friars came with Narvaez in 1528; their superior, Father Juan Suarez, was the first bishop in the United States. In the course of time the missionaries succeeded, though not without heavy sacrifices of life and labor, in establishing flourishing missions all along the coast and in the interior as far west as Mississippi and as far north as Georgia. In 1634 there were 34 friars, who maintained 44 mission stations, where they attended to about 30,000 converts. These missions suffered greatly by invasions from Carolina and Georgia, and when Florida was ceded to the English in 1763 they ceased to exist.

Arizona and New Mexico were first visited by Franciscans in 1539; in the course of time a great many missions and churches were established, to most of which were attached schools for boys, as we learn from an official report of 1632. Beginning with 1689, about 160 friars labored in Texas up to the time of the Mexican independence, when the missions were ruined.

The Franciscans came to California in 1768 under the renowned Father Junipero Serra. The first mission founded was San Diego. Up to 1823, 21 missions were organized, forming a chain which extended a distance of over 700 miles. At the height of mission prosperity 30,000 Indians lived under the paternal guidance of the friars; they were fed, clothed, and educated, with no expense to the government, the missions supporting themselves by agriculture and stock-raising; everything was manufactured at these establishments by the Indians. In 1834 the Mexican government began to confiscate the missions and took them from the control of the friars; this work was finished by 1846 and brought about the complete destruction of the once so flourishing missions.

While the Spanish Franciscans were thus extending their labors in the south from the Atlantic to the Pacific, other bands of Friars Minor were emulating their example in the north. Champlain induced the French Franciscans, formerly called Recollects, to come to Canada as early as 1615. Thence they penetrated into Maine, New York, Pennsylvania, Michigan, Illinois, Minnesota, and Wisconsin. The best known of these missionaries is Father Louis Hennepin. He accompanied La Salle on his expeditions, and was the first to publish a description of the Niagara Falls. While a captive among the Sioux he saw and named the Falls of Saint Anthony. About this time we find the English Franciscans laboring in Maryland and adjoining colonies for full half a century. In the beginning of the 19th century the Rt. Rev. Michael Egan, a Franciscan and first bishop of Philadelphia, intended establishing a province of his order in Pennsylvania, but he died before accomplishing his design. In 1845 Franciscans from the Tyrol came to Cincinnati; in 1854 Italian friars formed a community in western New York, and in 1858 German friars settled in Illinois. The "Kulturkampf" was the cause of many more coming to the United States.

At present (1905) there are in the States 1,033 Franciscans, who are distributed as follows: The Custody of the Immaculate Conception (New York city) in the Eastern States has 8 houses, with 37 members; the Province of the Holy Name (Paterson, N. J.), also in the Eastern States, has 12 houses, with 132 members; the Province of Saint John the Baptist (Cincinnati, Ohio), chiefly in the Central States, has 33 houses, with 343 members; the Province of the Sacred Heart (Saint Louis, Mo.), in the Central and Northern States, has, including the houses in California and Arizona and the Polish communities in Wisconsin, 44 houses, with 521 members. Most of these friars are engaged in regular parish work; some preach missions throughout the States; others are on the Indian missions in Michigan, Wisconsin, California, Arizona, and New Mexico. They also conduct one seminary (Allegany, N. Y.) and six colleges (Allegany, N. Y., Cincinnati, Ohio, Teutopolis, Ill., Quincy, Ill., Pulaski, Wis, Santa Barbara, Cal.).

The Conventual Friars Minor came to the United States in 1851, and at present (1905) form a province in New York and New Jersey numbering 120 members. Besides these there are in the States 134 Franciscan Brothers and some 7,800 Sisters, all belonging to the third Order of Saint Francis. In 1897 the four abovementioned groups, namely, Observants, Reformati, Alcantarines, and Recollects, who had always been under the same minister-general, dropped their distinctive traits and are now known simply as Friars Minor or Franciscans. They number at present (1905) 16,801, are distributed into 77 provinces, and have 1,498 houses. In 1893 the Conventuals numbered 1,462, which number has since decreased, and had 172 houses.

Consult: Shea, 'Catholic Church in the U. S.'; Hammer, 'The Franciscans in America'; Engelhardt, 'Franciscans in California'; 'Franciscans in Arizona.'

Rev. P. Hugoline Storff, O.F.M.

Franck, César Auguste Jean Guillaume Hubert, sä'zar ō-güst zhŏṅ gē-yōm übār, fränk, French composer: b. Liège 1822: d. Paris 1890. He studied in the conservatory of his native town and at Paris, and in 1872 succeeded his master, Benoist, as teacher in the Metropolitan Conservatory. His talent as a composer was for a long time unrecognized, and in 1846 his oratorio 'Ruth' fell flat. Twenty years later it was revived and created a furore, and Franck found himself leader of a new school. The popularity which his works still enjoy at Paris has to some extent spread to the United States, where his oratorio 'Les Beatitudes' has been much appreciated.

Francke, August Hermann, ow'goost hĕr'män frän'kė, German Lutheran clergyman and philanthropist: b. Lübeck 22 March 1663; d. Halle 8 June 1727. In 1692 he obtained the professorship of Oriental languages at Halle, which in 1698 he exchanged for that of theology. A pupil of Spener and the teacher of Zinzendorf, Francke belonged to the ranks of those who carried forward the pietistic movement; his activity, however, took the practical direction of founding, endowing, and organizing various educational institutions at Halle. Among these were a school for the poor, a pædagogium, a burgher school, a Latin school, and a seminary for training teachers for these establishments, all founded in one year, 1695; and with them was associated an orphanage, which became in the course of time the most important of all Francke's institutions. At the time of his death his schools were frequented by more than 2,300 pupils. Francke's principal aim was religious instruction, but he founded also a printing-office, and an apothecary's shop, and taught natural science and physical exercises and manual trades. At the present time all Francke's foundations exist with but little alteration; in addition to those mentioned there are also a real-gymnasium, two schools for girls, and a free school. The number of pupils is more than 3,000 annually. See 'Lives' by Kramer (2d ed. 1885); Stein (2d ed. 1886).

Francke, Kuno, American educator: b. Schleswig, Germany, 27 Sept. 1855. Was educated at Kiel; came to the United States and has been professor of German literature in Harvard University for many years. His notable book 'Social Forces in German Literature' appeared in 1896; followed by 'Glimpses of Modern German Culture' (1898); 'History of German Literature' (1901); etc.

Francken, Frans, fräns fränk'ĕn (called The Younger), Flemish painter: b. Antwerp May 1581; d. there 6 May 1642. After a trip to Italy he was received into the Guild of St. Luke at Antwerp, where he worked at first in the brilliant colors of the old masters and later in the realistic style of Rubens. Most prominent European galleries have examples of his art.

Francken, Frans (called The Third), Flemish painter: b. Antwerp 1607; d. there 2 Sept. 1667. He was admitted to the Guild of Saint Luke in 1639. His works, patterned after Rubens, are unsigned and therefore difficult of identification. Specimens of his religious subjects are to be seen at Augsburg ('Moses Striking Water from the Rock') and Vienna,

Liechtenstein collection ('John the Baptist Preaching'). In later years he also conducted a linen-draper's shop. He was a son of Frans Francken called The Younger (q.v.).

Franco, Giovanni Battista, jō-vän'nē bät-tēs'tä frän'kō, Italian painter, called Il Semolei: b. Udine 1510; d. Venice 1580. He visited Rome, where his Venetian manner was much influenced by that of Michelangelo. He was a very busy and uneven artist, doing his best work in decorative lines. Upon the victorious entry of Charles V. of Spain into Rome in 1536 he embellished the triumphal arch with scenes descriptive of the city's history. His principal canvas is a 'Baptism of Christ' in the Venetian Church of San Francesco della Vigna. His etchings, including such plates as 'The Adoration of the Shepherds' and 'The Scourging of Christ' (after Titian), are by many preferred to his paintings, which are criticised for defects of color.

Franco-German or **Franco-Prussian War**, the stupendous conflict between France and Germany in 1870–1, which resulted in the total defeat of the French, the overthrow of the Napoleonic dynasty, the establishment of the Third Republic in France, and the consolidation of Germany into an empire under the leadership of Prussia.

The remote causes of this war are to be sought in the jealousy which had long existed between France and Prussia, and which was strengthened on the side of France by the Prussian defeat of Austria in 1866, which secured to her rival the unquestioned leadership in Germany. The immediate occasion of the war occurred in June 1870, when Gen. Prim, commanding in Spain after the deposition and abdication of Queen Isabella, offered the crown of that country to Leopold of Hohenzollern, a prince belonging to the reigning house of Prussia. It was thought in France that the acceptance of this offer would endanger the balance of power in Europe, and more particularly would threaten the safety of France, by putting Prussia in a position to attack it both in the east and in the south. Accordingly, the government of Napoleon III. demanded of the king of Prussia that he should forbid the candidature of the prince. The prince voluntarily retired from his candidature, but the French ambassador offensively insisted that this renunciation should be formally made by the king, and a guarantee given that the candidature would not be revived. This demand was refused, and a formal declaration of war by France against Prussia was received by Count Bismarck, the chancellor of the North German Confederation, on the 19th of July. The war was welcomed by both sides with equal enthusiasm. While the French were the first in getting their troops to the frontier it soon became manifest that instead of being in a complete state of readiness, as the minister of war had declared, the army was defective in almost everything essential to its equipment. Owing to the prevalence of the system of paying for substitutes who never appeared, and were yet registered as belonging to the army, it was also discovered that the numbers of the army did not reach anything like the amount at which they were represented in the official estimates.

In contrast to this the arrangements for mobilizing the Germany army, which had previously been tested in Prussia in 1864 and 1866, were again found to work admirably. Each section of the army was completely organized in the headquarters of the district which it occupied in time of peace, and was only sent to the frontiers after being furnished with everything it required. In addition to this, Prussia, against which country alone the war had been declared, was not only joined according to treaty by all the states of the North German Confederation, but also by those of the south, upon whose neutrality, perhaps even upon whose alliance, Napoleon and the French had counted. The whole of Germany north and south was thus in arms, and was able to muster forces far outnumbering those of the French. While the whole French army brought into the field at the commencement of the war numbered no more than 310,000 men, the troops of the Germans in the field amounted in all to 477,000, to which must be added strong reserves ready, with the exception of such as were necessary to protect the interior and to resist a threatened landing on the north coast by the French fleet, to be brought to the scene of war at any time, giving a total strength on the side of the Germans of more than 1,000,000 of men.

The German forces were divided into three armies; the First Army had its headquarters at Trèves under Gen. Steinmetz; the Second Army occupied the Bavarian Palatinate under Prince Frederick Charles; while the Third Army, under the Crown-prince of Prussia, was stationed in northern Baden. The cavalry of each army, instead of being attached in separate divisions to each of the corps d'armée composing the army, were in this way massed together into one body, and in this formation rendered very important services during the war. The commander-in-chief of the whole forces was King William of Prussia, who was supported by a staff of general officers, with Von Moltke at their head. The French army, under Napoleon himself, had its headquarters at Metz, and two advanced divisions were stationed on the borders of France and Germany, the one in the north on the Saar, under Gen. Frossard, the other farther south at Weissenburg, under Gen. Douay. The first overt act of war took place on 2 August, in which a part of the northern division of the French army, in the presence of Napoleon and the prince imperial, compelled a few Prussian troops belonging to the First Army, after some hours' firing, to evacuate Saarbrücken. After this Von Moltke assumed the offensive. His plan was to unite the three armies in the line of the Moselle in order to attack the enemy's centre with the view of obtaining the shortest line of operations in the direction of Paris, and in this he was completely successful. On 4 August the army under the crown prince defeated the advanced southern division of the French army at Weissenburg, and on 6 August MacMahon's army at Wörth; on the latter date also the first and second German armies had routed the northern division of the French army at Forbach, with terrible loss on both sides. In two separate armies, commanded respectively by Marshal Bazaine and Marshal MacMahon, the French retreated. To prevent their union Steinmetz and Frederick Charles pursued Bazaine, defeated him at Courcelles on 14 August, at Mars-la-Tour on the 16th, at Gravelotte with awful slaughter on the

18th, and shut him up in Metz. The crown prince and his army following MacMahon, advanced to Nancy; there reinforced by a newly formed army under the crown prince of Saxony, they advanced on Châlons, where MacMahon's army had been reorganized and strengthened, and was expected to retreat on Paris. Following instructions, however, MacMahon moved northward to make a descent upon Metz and relieve Bazaine. He was overtaken near Beaumont, and on 27 August and on the days immediately succeeding a number of engagements and strategic movements resulted in MacMahon's army being surrounded at Sedan on 1 September, by a force of overwhelming numbers. On the following day both army and fortress were forced to capitulate. Forty generals, 4,000 officers of all grades, and 84,000 soldiers became prisoners of war. Among the prisoners was Napoleon III., who was unexpectedly found to have been present with the army of MacMahon. On the day after the battle he had a personal interview with King William of Prussia, who assigned to him Wilhelmshöhe, near Cassel, as a place of residence during his captivity.

At the news of this disastrous defeat the Parisians in an outburst of rage demanded the dethronement of the Napoleon dynasty, and on 4 September a republic was proclaimed. A government of national defense presided over by Gen. Trochu, military governor of Paris, was formed, but before any effective measures could be adopted Paris was invested by the Germans on 19 September. A day or two before a delegation from the central government had escaped from Paris and established themselves at Tours, where they were joined on 9 October by Gambetta, who escaped from Paris by balloon. It was some time before the French were able to organize a new army, and in the meantime, 27 September, Strasburg fell into German hands and on 28 October Metz, which had been invested by the second German army under Prince Frederick Charles, capitulated. By the beginning of November war in the open field had been resumed at various points: in the north, in the southeast, and on the Loire in the neighborhood of Orleans. The army of the Loire, under Gen. Aurelle de Paladines, compelled the Germans to evacuate Orleans on 7 November, but was unable to follow up this temporary success, and on 4 December and on 12 January was severely defeated by Prince Frederick Charles. The army of the north, under Gen. Faidherbe, which had been hastily formed to attempt the relief of Paris, after many gallant attempts which were checked by the first German army under Gen. Manteuffel, was finally defeated at St. Quentin on 19 January. In the east and southeast the results were equally disastrous to the French. Gen. Werder defeated the French troops under Cambriels in the Vosges, the irregular forces under Garibaldi in Burgundy, and at Héricourt on the Lisaine on 15, 16 and 17 January kept in check the army of Bourbaki until the approach of Manteuffel compelled Bourbaki and 84,000 troops to escape into Switzerland, where they were disarmed and remained till the conclusion of the war. Meanwhile Paris had held out for a much longer period than even the most sanguine on the side of the French had expected. Desperate sallies were frequently made, but not in sufficient strength to have any decisive effect. On the failure of the last sally on 19 January, Gen. Trochu resigned and was succeeded by Leflô as head of the government of defense, and by Gen. Vinoy as commander of the troops of Paris. But by this time the city was at the point of starvation, and after a three weeks' bombardment was in such a desperate condition that the government could no longer help seeing that a capitulation was inevitable. The terms were settled on 28 January, the chief being that all the forts around Paris should be immediately handed over to the Germans, and that the city should pay a contribution of 200,000,000 francs ($40,000,000). An armistice of three weeks was at the same time concluded, to allow of the election and assembling of a National Assembly to decide upon war and peace. This armistice, however, was not to extend to the scene of war in the southeast until a separate arrangement had been made regarding it. Here the fortress of Belfort still held out, but at last, on 16 February, it agreed to capitulate. The garrison, on account of its gallant defense, was allowed to march out with full military honors. On the same day the armistice became general. The fortress of Bitsch in the department of Moselle, did not surrender till after the conclusion of the preliminaries of peace.

The elections for the assembly had taken place on the 8th; it met at Bordeaux, and on the 17th appointed M. Thiers head of the executive; and on the 21st he arrived at Versailles with a diplomatic commission to negotiate for peace. After the armistice had been thrice prolonged the preliminaries of peace were signed at Versailles on 26 February, and accepted by the assembly at Bordeaux on 1 March. On the same day the German troops entered Paris; on 18 January King William, who had taken up his residence at Versailles, had by acclamation been proclaimed Emperor of Germany. The principal terms of peace were: (1) That France should cede to Germany one fifth part of Lorraine, including Metz, together with the whole of Alsace except Belfort and the surrounding district. (2) That France should pay to Germany a war indemnity of 5,000,000,000 francs ($1,000,000,000). (3) That certain departments of France should remain in the occupation of the Germans, and should not be fully evacuated until after the payment of the whole indemnity. The definitive treaty of peace, which was signed at Frankfort on 10 May and ratified on the 21st, confirmed in all essential particulars the preliminaries of Versailles. The last instalment of the war indemnity was paid on 5 Sept. 1873, and France was completely evacuated by the Germans on the 13th of the same month.

François, Kurt von, koort fōn frän-swä, German explorer: b. Grand-duchy of Luxembourg 2 Oct. 1853. After active service in the Franco-Prussian war, he joined, with the rank of lieutenant, the Wissmann expedition to explore the river Kassai, a tributary of the Congo, and subsequently published his work 'In the Interior of Africa, the exploration of the Cassai, during 1883–5' (1891). He then explored with Grenfell two southern tributaries of the Congo and published his 'Exploration of the Tschuapa and Lulongo' (1888). He was on his return promoted to be leader of an expedition which

the government despatched to the German colony of Togo, and 1890–1 accompanied the military expedition into South Africa and in 1892 traversed the Kalahari Desert.

François, Luise von, German novelist: b. Herzburg, Saxony, 27 June 1817; d. Weissenfels 24 Sept. 1893. Her first considerable story, 'The Last Reckenburgerin' (1871), was very warmly praised by the critics for its power in character delineation; it was followed by: 'Frau Erdmuthen's Twin Boys' (1872); 'Climacteric Years of a Lucky Fellow' (1877); 'Judith the Housekeeper' (1868), a peasant counterpart to 'The Last Reckenburgerin,' and next after that her best story. She wrote a 'Popular History of the Prussian War of Liberation, 1813–15'; and a comedy, 'Woman's Station' (1882).

Fran'colins, a genus of small partridges of Africa and southern Asia, much resembling the American bobwhite in behavior. One species (*Francolinus vulgaris*) used to be common in the south of Europe, but has been exterminated.

Franco'nia, Germany, a district lying to the east of the Rhine, and traversed by the Main. After the dismemberment of the Carlovingian empire this district became attached to the German division, and ultimately formed one of the grand-duchies of Germany. Between 1024 and 1125 it furnished a series of emperors to Germany. (See GERMANY, *History*.) It was one of the ten circles into which the empire was divided by Maximilian I. in 1512. Its capital was Nuremberg. In 1806 it was partitioned among Würtemberg, Baden, Hesse-Cassel, the Saxon duchies, and Bavaria. The last received the largest share, and still retains the name in the three circles of Upper, Middle, and Lower Franconia. (1) Upper Franconia has an area of 2,702 square miles and pop. (1900) 607,903. Baireuth is the capital. (2) Middle Franconia has an area of 2,925 square miles and pop. (1900) 815,556. The capital is Anspach. (3) Lower Franconia has an area of 3,243 square miles and pop. (1900) 650,758. Würzburg is the capital. The name of Franconia has been rendered familiar to the traveler and the geologist by its picturesque scenery, which has procured for part of it the name of Franconian Switzerland, and by its caverns, filled with fossil bones, among the most remarkable of which is König Ludwig's Höhle (King Louis' Cave), between Baireuth and Muggendorf.

Franconia Mountains. See WHITE MOUNTAINS.

Fran'gula, the bark of *Rhamnus Frangula,* used in medicine as a purgative.

Fran'gulin ($C_{20}H_{20}O_{10}$), a dyestuff extracted from the root, bark, fruit, and seed of the alder buckthorn (*Rhamnus frangula*). It is a bright yellow, silky, crystalline mass, without taste or smell, which fuses on heating, and can be sublimed in golden needles. It is not soluble in water, and though soluble in hot alcohol separates very completely on cooling. It dissolves in alkalies with a purple color, and is decomposed by sulphuric acid with a succession of colors. It forms lakes with metallic hydrates, and dyes silk, wool, and cotton. In its chemical constitution it is a glucoside, and it is probably the same as *cascara sagrada.*

Frank, Jakob, yä'kōb fränk (properly **Lebowicz**), Jewish pseudo-Messiah: b. Galicia 1720; d. 10 Dec. 1791. The name Frank was obtained during travel in the east from the Turks, who employed the word as a generic term for an European. Originally a distiller, he settled, after his eastern journey, in Podolia, where he professed himself a second Messiah, basing his teachings, in opposition to the Talmud, on the Sohar, the source of the Cabbala. He finally removed to Offenbach, where he lived regally on the gifts of adherents, and finally became a Roman Catholic. His death by apoplexy broke down popular belief in his immortality. The sect of Frankists persists in Poland, Turkey, and Moldavia, its tenets being a Judaized form of the Roman Catholic faith.

Frank, Royal Thaxter, American military officer: b. Gray, Maine, 6 May 1836. He was graduated at the United States Military Academy in 1864, and during the Civil War was brevetted major and lieutenant-colonel for bravery at Fredericksburg, 13 Dec. 1862. He was in command of the Artillery School at Fortress Monroe 1888–98, and was promoted brigadier-general in 1898.

Frank'enstein, or the Modern Prometheus, a psychological romance, by Mary Wollstonecraft Shelley (daughter of Mary Wollstonecraft Godwin and wife of the poet Shelley), published in 1817. It has a morbid power which makes it one of the most remarkable books of its kind in English. Frankenstein conceives the idea of creating by mechanical means a living being, who, independent of the ills of the flesh, shall be immortal. Like Prometheus of old, he hopes to bring down a vital spark from heaven to animate the human frame. After a long series of laboratory experiments, in which he sees himself gradually approaching his goal, he succeeds. But his creation turns out to be not a blessing but a curse. He has made a soulless monster, who will implacably pursue Frankenstein and all his loved ones to the dire end. In vain the unhappy scientist flees from land to land, and from sea to sea. The fiend he has brought into existence is ever on his track, and is the evil genius of his whole family. Finally, in an ice-bound sea, worn out by his hideous experiences, he dies, and over his dead body hovers the horrid shape of the man-machine. The monster then leaps over the ship's side, and disappears in the ice and mist.

Frankfort, Ind., city, county-seat of Clinton County; on the Louisville, N. A. & C., the L. E. & W., the St. L. & K. C., and the Vandalia R.R.'s; about 40 miles northwest of Indianapolis, and 91 miles southwest of Fort Wayne. It is in an agricultural section, and its chief manufactures are flour, crackers, lumber, tiles, bricks, agricultural implements, and some furniture. Natural gas is used extensively for light and heat. The trade is chiefly in the manufactured articles and grain, fruits, and vegetables. The city has a fine public library and a well organized system of public schools. The electric-light plant is owned by the city. Pop. (1900) 7,100.

Frankfort, Ky., city, capital of the State of Kentucky, county-seat of Franklin County; on the Kentucky River, the Chesapeake & O., and the L. & N. R.R.'s; about 50 miles east of Louisville and 65 miles southwest of Cincinnati. The city was founded by Gen. James Wilkinson (q.v.) in 1786, and for a time it was

made the seat of his intrigues when he was trying to detach Kentucky from the Union and affiliate it with Spain. When Kentucky was admitted as a State in 1792, Frankfort was made the capital. During the Civil War it was for a time the headquarters of the Confederate forces under Braxton Bragg (q.v.). On 4 Oct. 1862 Richard Harves was inaugurated here as the Confederate governor of Kentucky. In 1900 there was great excitement in Frankfort as to who was elected governor of the State. It was decided that William Goebel was the governor-elect. In the midst of the agitation Goebel was assassinated. Frankfort owes much of its present prosperity to its location in the "Blue Grass" section of the State. Its chief manufactures are flour, whiskey, lumber, carriages, twine, shoes, furniture. The city is the trade centre for an extensive region; the river is navigable and by artificial means it is made to furnish a large amount of water power. The city contains the State arsenal, a State Home for Feeble-Minded Children, the State penitentiary, the State Normal School for colored pupils, and Saint Joseph's Academy. The State government buildings and the State library with over 100,000 volumes add to the interests of the city. Franklin cemetery contains the grave of Daniel Boone (q.v.) and other noted men connected with the history of Kentucky. Pop. (1900) 9,487.

Frank'fort-on-the-Main, mān, Prussia, the capital of a district of same name, on the Main, 20 miles above its conflux with the Rhine. It is divided by the river into two unequal parts; the one on the north bank, called Frankfort proper, being considerably larger than the other, which is called Sachsenhausen; and the two communicate by a stone bridge. Frankfort was formerly fortified; but most of its outworks are now converted into gardens and promenades, and it is entered by nine gates. The principal streets are wide; there are also many squares and a number of large buildings; among which may be named the Rœmerberg, or old palace, in which the emperors of Germany were elected, and place of the assembling of the Diet; the Taxis palace, a place of residence of the emperors; the Sallhof, a modern imperial palace; an academy of painting, and the Senkenberg Museum. Its manufactures include carpets, table-covers, oil-cloths, cotton and silk fabrics, woolen stuffs, jewelry, tobacco and printer's black. It has also large printing, lithographic and stereotyping establishments. Frankfort was founded by the Franks in the 5th century. Charlemagne, who had a palace in this city, summoned a council in 794, and it was surrounded with walls by Louis I. in 838. It was the capital of the Eastern Franks from 843 to 889, when Ratisbon was selected. Frederick I. was elected at Frankfort in 1152. From that time it became the place of election of the emperors. Frankfort was made a free city in 1257. The bridge over the Main was built in 1342. Frederick of Prussia signed a treaty known as the Union of Frankfort, with the empire, France, and Sweden, at this city 13 May 1744. The French captured it 2 Jan. 1750, and again in 1792; but the Prussians wrested it from them 2 Dec. 1792. It was bombarded by the French 12 July, and surrendered 19 July 1796. It formed part of the Confederation of the Rhine in 1806. Napoleon I. erected Frankfort into a duchy in 1810. The Declaration of the Allied Powers was issued at Frankfort 1 Dec. 1813. By the Congress of Vienna, in 1815, it was made one of the four free cities of Germany, and the seat of the Germanic Diet. It was made a free port in 1831. The constituent assembly, elected in 1848, held its sittings at Frankfort. It was occupied by the Prussians 16 July 1866, and is now incorporated with Prussia. Pop. (1900) 288,489.

Frankfort-on-the-Oder, Prussia, the capital of a district of the same name, province of Brandenburg, 48 miles from Berlin. Its university, founded in 1506, was in 1811 transferred to Breslau. Manufactures are woolens, silks, leather, earthen-ware, tobacco, mustard, etc. Near it is Kunersdorf, the scene of the victory of the Austrians and Russians over Frederick the Great (q.v.) in 1759. Pop. (1900) 61,835. The district has an area of 8,000 square miles, with a population of 1,000,000.

Frankfort Black, a fine black pigment used in copper plate engraving. It is said to be made by burning, in the manner of ivory black, the lees of wine from which the tartar has been washed.

Frankfort Land Company, 1686. Francis Daniel Pastorius, an able young German lawyer, had joined the sect of Pietists (q.v.), and to escape from the atmosphere of Lutheranism, concerted with his co-religionists an emigration to America. A number of wealthy and distinguished Germans and Dutchmen were induced to join; but they soon gave up the idea of emigrating themselves, and wished Pastorius instead to head a colony of German and Dutch Mennonites and Quakers to a land where they need not be harried. Pastorius had made Penn's acquaintance in England, had become a Quaker, and wished to be near Penn; some Crefeld merchants bought from Penn 15,000 acres near Philadelphia, and in 1683 Pastorius conducted a colony thither, and at once laid out Germantown (q.v.). In 1686 the Frankfort Land Company was organized, and bought 25,000 acres more.

Frankincense, frank'ĭn-sĕns (O. F. *franc encens;* Mod. Lat. *francum incensum*), a name given to various oleo-resinous substances. The frankincense employed in religious ceremonies (called also *incense* and *olibanum*) is a gum resin obtained from *Boswellia thurifera* (or *serrata*), a tree somewhat resembling the sumach, belonging to the *Amyridaceæ*, and inhabiting the mountains of India. The frankincense so highly prized by the Greeks, Romans and Jews was probably chiefly of this variety. Substances derived from other trees, such as Croton and Protium, are frequently employed as substitutes for *olibanum.* American turpentine, from which Burgundy pitch is obtained by melting and straining through a cloth, is frequently called frankincense. The frankincense familiar to pharmacy is procured from the European silver fir.

Franking Privilege, that of sending postal matter gratis. In England peers and members of the House of Commons had it till 1840, and till 1837 could also frank their friends' letters wholesale, and even leave franks with them to use at will. In the United States it was first accorded to Revolutionary soldiers in actual service; then to the executive body, chiefs of departments and bureaus, and some special clerks;

and all public documents were franked. Senators and Congressmen, postmasters for official correspondence, also had it; likewise newspaper exchanges and petitions to Congress; and later, exchanges of the Smithsonian institutions, and medals and testimonials to soldiers. The first four presidents had it for life, and it has been granted to the widows of ex-presidents. It was totally abolished from 30 June 1873, an allowance of stamps being made to the departments; but restored a few years later for public documents, seeds to constituents, etc. There is a penalty of $300 for unlawful use of envelopes marked "official business."

Frankl, Ludwig August, lood'vĭg ow'goost fränkl, Chevalier von Hochwart, Austrian poet: b. Chrast, Bohemia, 3 Feb. 1810; d. Vienna 14 March 1894. His literary début was made with 'A Lay of Hapsburg' (1832), a series of historical ballads, followed (1836) by the romantic epic 'Christopher Columbus'; the biblical romantic poem 'Rachel' (1842); a poem 'The University' (1848), the first publication in Austria not subjected to the official censorship; 'Don John of Austria,' a heroic poem (1846); 'Lyric Poems,' and 'Epic and Lyric Poetry.'

Frank'land, Sir **Edward,** English chemist: b. Churchtown, England, 18 Jan. 1825; d. Norway 11 Aug. 1899. He made the discovery of the union of organic radicles with metals, announcing in 1850 the preparation of compounds of zinc with methyl and ethyl. From this he deduced the conclusion that an atom of the metal could only attach itself to a definite number of the atoms of other elements, which discovery led to the theory of "equivalents." He was appointed professor of chemistry at Owens College, Manchester, in 1851, and there developed the process of making water gas. Becoming professor of chemistry in the Royal School of Mines in 1865 he turned his attention to water analysis, the purification of sewage and the means of preventing pollution. Subsequently he proved that compressed gases are capable of giving out a flame of constant spectrum, from which he concluded that the photosphere of the sun was atmospheric. He also investigated the chemistry of foods. He published 'Experimental Researches on Pure, Applied and Physical Chemistry' (1878); 'Water Analysis for Sanitary Purposes' (1880).

Frankland, Percy Faraday, English chemist: b. London 3 Oct. 1858. He is a son of E. Frankland (q.v.). In 1880 he became demonstrator and lecturer on chemistry at the School of Mines, a post which he held till his appointment in 1888 as professor of chemistry in University College, Dundee. In 1894 he became professor of chemistry in Mason College, Birmingham. His published works, which deal mostly with micro-chemistry, the chemistry of fermentation and bacteriology, include 'Agricultural Chemical Analysis' (1883); 'Our Secret Friends and Foes' (1894, on micro-organisms); 'Micro-organisms in Water' (1894); 'Life of Pasteur' (1897); and many lectures and papers in the transactions of various societies. In several of his works he has been assisted by his wife, the sister of the philanthropist Arnold Toynbee (q.v.).

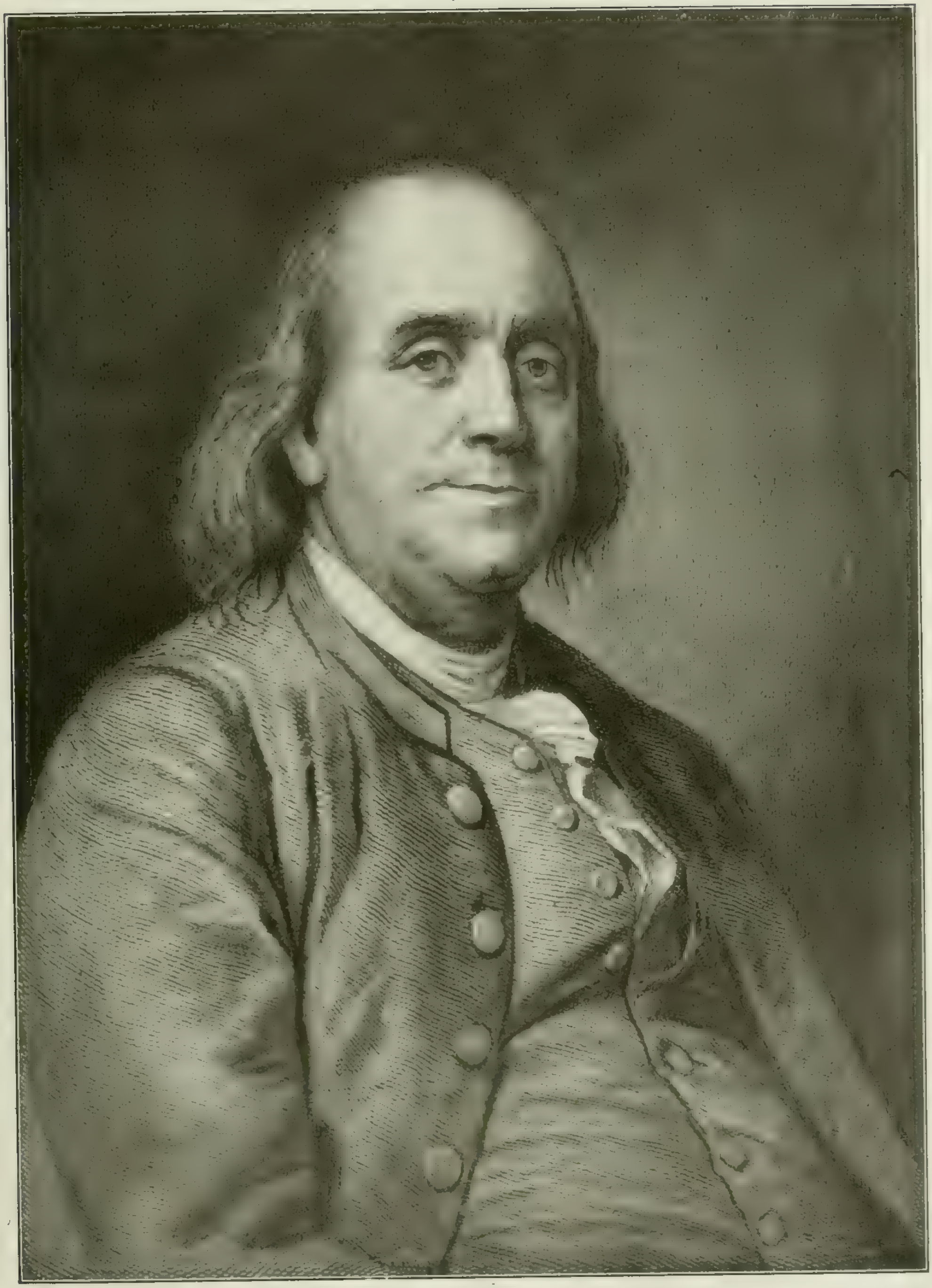
Franklin, Benjamin, American statesman and philosopher: b. Boston, Mass., 17 Jan. 1706; d. Philadelphia, Pa., 17 April 1790. The youngest son of the 17 children of a Boston tallow-chandler named Franklin was born a subject of Queen Anne of England, and on the same day received the baptismal name of Benjamin at the Old South Church in that city. He continued for more than 70 of the 84 years of his life a subject of four successive British monarchs. During that period, neither Anne nor either of the three Georges who succeeded her had a subject of whom they had more reason to be proud, nor one whom at his death their people generally supposed they had more reason to detest. No Englishman of his generation can now be said to have established a more enduring fame, in any way, than Franklin established in many ways. As a printer, as a journalist, as a diplomatist, as a statesman, as a philosopher, he was easily first among his peers.

On the other hand, it is no disparagement of the services of any of his contemporaries on either side of the Atlantic, to say that no one of his generation contributed more effectually to the dissolution of the bonds which united the principal British-American colonies to the mother country, and toward conferring upon them independence and a popular government.

As a practical printer Franklin was reported to have had no superiors; as a journalist he exerted an influence not only unrivaled in his day, but more potent, on this continent at least, than either of his sovereigns or their parliaments. The organization of a police, and later of the militia, for Philadelphia; of companies for extinguishing fires; making the sweeping and paving of the streets a municipal function; the formation of the first public library for Philadelphia, and the establishment of an academy which has matured into the now famous University of Pennsylvania, were among the conspicuous reforms which he planted and watered in the columns of the Philadelphia *Gazette*. This journal he founded; upon the earnings of it he mainly subsisted during a long life, and any sheet of it to-day would bring a larger price in the open market probably than a single sheet of any other periodical ever published.

Franklin's Almanack, his crowning work in the sphere of journalism, published under the pseudonym of "Richard Saunders,"— better known since as Poor Richard,— is still one of the marvels of modern literature. Under one or another of many titles the contents of this publication, exclusive of its calendars, have been translated into every tongue having any pretensions to a literature; and have had more readers, probably, than any other publication in the English or indeed in any other language, with the single exception of the Bible. It was the first issue from an American press that found a popular welcome in foreign lands, and it still enjoys the special distinction of being the only almanac ever published that owed its extraordinary popularity entirely to its literary merit.

What adds to the surprise with which we contemplate the fame and fortunes of this unpretentious publication, is the fact that its reputation was established by its first number, and when its author was only 26 years of age. For a period of 26 years, and until Franklin ceased to edit it, this annual was looked forward to by a larger portion of the colonial population and with more impatience than now awaits a President's annual message to Congress.



BENJAMIN FRANKLIN.

Franklin graduated from journalism into diplomacy as naturally as winter glides into spring. This was simply because he was by common acclaim the fittest man for any kind of public service the colony possessed, and especially for any duty requiring talents for persuasion, in which he proved himself to be unquestionably past master among the diplomatists of his time.

The question of taxing the Penn proprietary estates in Pennsylvania, for the defense of the province from the French and Indians, had assumed such an acute stage in 1757 that the Assembly decided to petition the king upon the subject; and selected Franklin, then in the 41st year of his age, to visit London and present their petition. The next 41 years of his life were practically all spent in the diplomatic service. He was five years absent on this his first mission. Every interest in London was against him. He finally surmounted all obstacles by a compromise, which pledged the Assembly to pass an act exempting from taxation the unsurveyed lands of the Penn estate,— the surveyed waste lands, however, to be assessed at the usual rate. For his success the Penns and their partisans never forgave him, and his fellow colonists never forgot him.

Franklin returned to Philadelphia in 1762, but not to remain. The question of taxing the colonies without representation was soon thrust upon them in the shape of a stamp duty, and Franklin was sent out again to urge its repeal. He reached London in November 1764, where he remained the next 11 years and until it became apparent that the surrender of the right to arbitrarily tax the colonies would never be made by England during the life of the reigning sovereign, George III. Satisfied that his usefulness in England was at an end, he sailed for Philadelphia 21 March 1775; and on the morning of his arrival was elected by the Assembly of Pennsylvania a delegate to the Continental Congress which consolidated the armies of the colonies, placed Gen. George Washington in command of them, issued the first Continental currency, and assumed the responsibility of resisting the imperial government; his last hope of maintaining the integrity of the empire having been dissipated by recent collisions between the people and the royalist troops at Concord and Lexington. Franklin served on 10 committees in this Congress. He was one of the five who drew up the Declaration of Independence in July 1776, and in September following was chosen unanimously as one of the three commissioners to be sent out to solicit for the infant republic the aid of France and the sympathies of continental Europe. In this mission, the importance of which to his country can hardly be exaggerated, he was greatly favored by the reputation which had preceded him as a man of science. While yet a journalist he had made some experiments in electricity, which established its identity with lightning. The publication by an English correspondent of the letters in which he gave an account of these experiments, secured his election as an honorary member of the Royal Society of London and undisputed rank among the most eminent natural philosophers of his time. When he arrived in Paris, therefore, he was already a member of every important learned society in Europe, one of the managers of the Royal Society of London, and one of the eight foreign members of the Royal Academy in Paris, where three editions of his scientific writings had already been printed. To these advantages must be added another of even greater weight: his errand there was to assist in dismembering the British empire, than which nothing of a political nature was at this time much nearer every Frenchman's heart.

The history of this mission, and how Franklin succeeded in procuring from the French king financial aid to the amount of 26,000,000 francs, at times when the very existence of the republic depended upon them, and finally a treaty of peace more favorable to his country than either England or France wished to concede, has been often told; and there is no chapter in the chronicles of this republic with which the world is more familiar.

Franklin's reputation grew with his success. «It was,» wrote his colleague John Adams, «more universal than that of Leibnitz or Newton, Frederick the Great or Voltaire, and his character more beloved and esteemed than all of them. . . . If a collection could be made of all the gazettes of Europe for the latter half of the 18th century, a greater number of panegyrical paragraphs upon *le grand Franklin* would appear, it is believed, than upon any other man that ever lived.»

A few weeks after signing the definitive treaty of peace in 1783, Franklin renewed an application which he had previously made just after signing the preliminary treaty, to be relieved of his mission, but it was not until 7 March 1785 that Congress adopted a resolution permitting «the Honorable Benjamin Franklin to return to America as soon as convenient.» Three days later, Thomas Jefferson was appointed to succeed him. On 13 Sept. 1785, and after a sojourn of nearly nine years in the French capital, first in the capacity of commissioner and subsequently of minister plenipotentiary, Franklin once more landed in Philadelphia, on the same wharf on which, 62 years before, he had stepped, a friendless and practically penniless runaway apprentice of 17. Though now in his 79th year, and a prey to infirmities not the necessary incidents of old age, he had scarcely unpacked his trunks after his return when he was chosen a member of the municipal council of Philadelphia, and its chairman. Shortly after, he was elected president of Pennsylvania, his own vote only lacking to make the vote unanimous. «I have not firmness,» he wrote to a friend, «to resist the unanimous desire of my country folks; and I find myself harnessed again into their service another year. They engrossed the prime of my life; they have eaten my flesh, and seem resolved now to pick my bones.»

He was unanimously re-elected to this dignity for the two succeeding years, and while holding that office was chosen a member of the convention which met in May 1787 to frame the Constitution under which the people of the United States are still living. With the adoption of that instrument, to which he probably contributed as much as any other individual, he retired from official life; though not from the service of the public, to which for the remaining years of his stay on earth his genius and his talents were faithfully consecrated. Among the fruits of that unfamiliar leisure, always to be remembered among the noblest achievements of his illustrious career, was the part he had in

organizing the first anti-slavery society in the world; and as its president, writing and signing the first remonstrance against slavery ever addressed to the Congress of the United States.

In surveying the life of Dr. Franklin as a whole, the thing that most impresses one is his constant study and singleness of purpose to promote the welfare of human society. It was his daily theme as a journalist, and his yearly theme as an almanac-maker. It is that which first occurs to us when we recall his career as a member of the Colonial Assembly; as an agent of the provinces in England; as a diplomatist in France; and as a member of the conventions which crowned the consistent labors of his long life. Nor are there any now so bold as to affirm that there was any other person who could have been depended upon to accomplish for his country or the world what Franklin did in any of the several stages of his versatile career.

Though holding office for more than half of his life, the office always sought Franklin, not Franklin the office. When sent to England as the agent of the colony, he withdrew from business with a modest competence judiciously invested mostly in real estate. He never seems to have given a thought to its increase. Frugal in his habits, simple in his tastes, wise in his indulgences, he died with a fortune neither too large nor too small for his fame as a citizen or a patriot. For teaching frugality and economy to the colonists, when frugality and economy were indispensable to the conservation of their independence and manhood, he has been sneered at as the teacher of a "candle-end-saving philosophy," and his 'Poor Richard' as a "collection of receipts for laying up treasures on earth rather than in heaven." Franklin never taught, either by precept or example, to lay up treasures on earth. He taught the virtues of industry, thrift, and economy, as the virtues supremely important in his time, to keep people out of debt and to provide the means of educating and dignifying society. He never countenanced the accumulation of wealth for its own sake, but for its uses,— its prompt convertibility into social comforts and refinements. It would be difficult to name another man of any age to whom an ambition to accumulate wealth as an end could be imputed with less propriety. Though probably the most inventive genius of his age, and thus indirectly the founder of many fortunes, he never asked a patent for any of his inventions or discoveries. Though one of the best writers of the English language that his country has yet produced, he never wrote a line for money after he withdrew from the calling by which he made a modest provision for his family.

For the remaining half of his life both at home and abroad, though constantly operating upon public opinion by his pen, he never availed himself of a copyright or received a penny from any publisher or patron for any of these labors. In none of the public positions which he held, even when minister plenipotentiary, did his pay equal his expenditures. He was three years president of Pennsylvania after his return from France, and for his services declined to appropriate to his own use anything beyond his necessary expenditures for stationery, postage, and transportation. It is not by such methods that men justly incur the implied reproach of "laying up treasures on earth," or of teaching a candle-end-saving philosophy.

Franklin courted fame no more than fortune. The best of his writings, after his retirement from journalism, he never gave to the press at all; not even his incomparable autobiography, which is still republished more frequently than any of the writings of Dickens or of Thackeray. He always wrote for a larger purpose than mere personal gratification of any kind. Even his bagatelles and *jeux d'esprit* read in the salons of Paris, though apparently intended for the eyes of a small circle, were inspired by a desire to make friends and create respect for the struggling people and the great cause he represented. Few if any of them got into print until many years after his decease. Franklin was from his youth up a leader, a lion in whatever circle he entered, whether in the printing-house, the provincial assemblies, as agent in England, or as a courtier in France. There was no one too eminent in science or literature, on either side of the Atlantic, not to esteem his acquaintance a privilege. He was an honorary member of every important scientific association in the world, and in friendly correspondence with most of those who conferred upon those bodies any distinction; and all this by force of a personal, not to say planetary, attraction that no one brought within his sphere could long resist.

Pretty much all of importance that we know of Franklin we gather from his private correspondence. His contemporaries wrote or at least printed very little about him; scarcely one of the multitude whose names he embalmed in his 'Autobiography' ever printed a line about him. All that we know of the later half of his life not covered by his autobiography, we owe almost exclusively to his private and official correspondence. Though reckoning among his warm friends and correspondents such men as David Hume, Dr. Joseph Priestley, Dr. Price, Lord Kames, Lord Chatham, Dr. Fothergill, Peter Collinson, Edmund Burke, the bishop of St. Asaph and his gifted daughters, Voltaire, the habitués of the Helvétius salon, the Marquis de Ségus, the Count de Vergennes, his near neighbors De Chaumont and Le Veillard, the *maire* of Passy,— all that we learn of his achievements, of his conversation, of his daily life, from these or many other associates of only less prominence in the Old World, might be written on a single foolscap sheet. Nor are we under much greater obligations to his American friends. It is to his own letters (and except his 'Autobiography,' he can hardly be said to have written anything in any other than the epistolary form; and that was written in the form of a letter to his son William, and most of it only began to be published a quarter of a century after his death) that we must turn to learn how full of interest and importance to mankind was this last half-century of his life. Beyond keeping copies of his correspondence, which his official character made a duty as well as a necessity, he appears to have taken no precautions to insure the posthumous fame to which his correspondence during that period was destined to contribute so much. Hence, all the biographies — and they are numberless — owe almost their entire interest and value to his own pen. All, so far as they are biographies,

are autobiographies; and for that reason it may be fairly said that all of them are interesting.

It is also quite remarkable that though Franklin's life was a continuous warfare, he had no personal enemies. His extraordinary and even intimate experience of every phase of human life, from the very lowest to the very highest, had made him so tolerant that he regarded differences of opinions and of habits much as he regarded the changes of the weather,—as good or bad for his purposes, but which, though he might sometimes deplore, he had no right to quarrel with or assume personal responsibility for. Hence he never said or did things personally offensive. The causes that he represented had enemies, for he was all his life a reformer. All men who are good for anything have such enemies. "I have, as you observe," wrote Franklin to John Jay the year that he retired from the French mission, "some enemies in England, but they are my enemies as an American; I have also two or three in America who are my enemies as a minister; but I thank God there are not in the whole world any who are my enemies as a man: for by his grace, through a long life, I have been enabled so to conduct myself that there does not exist a human being who can justly say, 'Ben Franklin has wronged me.' This, my friend, is in old age a comfortable reflection. You, too, have or may have your enemies; but let not that render you unhappy. If you make a right use of them, they will do you more good than harm. They point out to us our faults; they put us upon our guard and help us to live more correctly."

Franklin's place in literature as a writer has not been generally appreciated, probably because with him writing was only a means, never an end, and his ends always dwarfed his means, however effective. He wrote to persuade others, never to parade his literary skill. He never wrote a dull line, and was never *nimious*. The longest production of his pen was his autobiography, written during the closing years of his life. Nearly all that he wrote besides was in the form of letters, which would hardly average three octavo pages in length. And yet whatever the subject he touched upon, he never left the impression of incompleteness or of inconclusiveness. Of him may be said, perhaps with as much propriety as of any other man, that he never said a word too soon, nor a word too late, nor a word too much.

The Doric simplicity of his style; his incomparable facility of condensing a great principle into an apologue or an anecdote, many of which, as he applied them, have become the folk-lore of all nations; his habitual moderation of statement, his aversion to exaggeration, his inflexible logic, and his perfect truthfulness,—made him one of the most persuasive men of his time, and his writings a model which no one can study without profit. A judicious selection from Franklin's writings should constitute a part of the curriculum of every college and high school that aspires to cultivate in its pupils a pure style and correct literary taste.

There was one incident in Franklin's life, which, though more frequently referred to in terms of reproach than any other, will probably count for more in his favor in the Great Assize than any other of his whole life. While yet in his teens he became a father before he was a husband. He never did what men of the loftiest moral pretensions not unfrequently do,—shirk as far as possible any personal responsibility for his indiscretion. On the contrary, he took the fruit of it to his home; gave him the best education the schools of the country then afforded. When he went abroad, this son accompanied him, was presented as his son wherever he went, was presented in all the great houses in which he himself was received; he entered him at the Inns of Court, and in due time had him admitted to the English bar; made him his private secretary, and at an early age caused him to be appointed by the Crown governor of New Jersey. The father not only did everything to repair the wrong he had done his son, but at a time when he was at the zenith of his fame and official importance, publicly proclaimed it as one of the great errors of his life. The world has always abounded with bastards, but with the exception of crowned heads claiming to hold their sceptres by divine right, and therefore beyond the reach of popular criticism or reproach, it would be difficult to name another parent of his generation of anything like corresponding eminence with Franklin, who had the courage and the magnanimity to expiate such a wrong to his offspring so fully and effectively.

Franklin was not a member of the visible Church, nor did he ever become the adherent of any sect. With the Unitarian creed Dr. Franklin had more in common than with any other, though he was much too wise a man to suppose that there was but one gate of admission to the Holy City.

Franklin made a somewhat more definite statement of his views on the subject of religion, in reply to an inquiry from President Styles of Yale College, who expressed a desire to know his opinion of Jesus of Nazareth. Franklin's reply was written the last year of his life, and in the 84th of his age:

"You desire to know something of my religion. It is the first time I have been questioned upon it. But I cannot take your curiosity amiss, and shall endeavor in a few words to gratify it. Here is my creed. I believe in one God, the creator of the universe. That he governs it by his providence. That he ought to be worshipped. That the most acceptable service we render to him is doing good to his other children. That the soul of man is immortal, and will be treated with justice in another life respecting its conduct in this. These I take to be the fundamental points in all sound religion, and I regard them as you do in whatever sect I meet with them.

"As to Jesus of Nazareth, my opinion of whom you particularly desire, I think his system of morals and his religion, as he left them to us, the best the world ever saw or is like to see; but I apprehend it has received various corrupting changes, and I have, with most of the present Dissenters in England, some doubts as to his divinity; though it is a question I do not dogmatize upon, having never studied it, and think it needless to busy myself with it now, when I expect soon an opportunity of knowing the truth with less trouble. I see no harm, however, in its being believed, if that belief has the good consequence, as probably it has, of making his doctrines more respected and more observed; especially as I do not per-

ceive that the Supreme takes it amiss, by distinguishing the unbelievers in his government of the world with any peculiar marks of his displeasure.

"I shall only add, respecting myself, that, having experienced the goodness of that Being in conducting me prosperously through a long life, I have no doubt of its continuance in the next, though without the smallest conceit of meriting such goodness. My sentiments on this head you will see in the copy of an old letter enclosed, which I wrote in answer to one from an old religionist whom I had relieved in a paralytic case by electricity, and who, being afraid I should grow proud upon it, sent me his serious though rather impertinent caution."

Bibliography.— 'Autobiography,' edited by Bigelow (1868); also 'Life of Benjamin Franklin, Written by Himself,' edited by Bigelow (1888); 'Complete Works,' 10 vols., edited by Bigelow (1887–8). Mignet, 'Vie de Franklin' (1854); Parton, 'Life and Times of Benjamin Franklin' (1867); McMaster, 'Benjamin Franklin' (1887); Hale, 'Franklin in France' (1887–8); Morse, 'Benjamin Franklin' (1889); Ford, 'Franklin Bibliography' (1889); Ford (edited), 'Sayings of Poor Richard' (1890); Ford, 'The Many Sided Franklin' (1899); Fisher, 'The True Benjamin Franklin' (1899).

JOHN BIGELOW.

Franklin, Fabian, American mathematician and editor: b. Eger, Hungary, 18 Jan. 1853. After his graduation from Columbian University, Washington, in 1869, he engaged in civil engineering and surveying. In 1877 he became a fellow at Johns Hopkins University, and his advance to the associate and then full professorship of mathematics quickly followed. During his connection with Johns Hopkins, which lasted until 1895, he was a frequent contributor to mathematical and other journals. In 1895 he became editor of the Baltimore 'News.'

Franklin, SIR **John,** English navigator: b. Spilsby, Lincolnshire, 16 April 1786; d. Lancaster Sound 11 June 1847. When only a boy he went to sea, and later entered the English navy. In 1806 he was present at the battle of Trafalgar, in 1814 at that of New Orleans, and in 1819 was appointed to head an overland expedition from Hudson Bay to the Arctic Ocean. After suffering many hardships and being frequently on the verge of death from hunger and fatigue, he reached home in 1822. In the following year he married a Miss Purden, the daughter of an architect, and the author of several poetical effusions. In 1825 he submitted to Lord Bathurst a plan "for an expedition overland to the mouth of the Mackenzie River, and thence by sea to the northwest extremity of America, with the combined object also of surveying the coast between the Mackenzie and Coppermine rivers." This proposition was accepted, and six days after he left Liverpool, in the same year, his wife died. In 1827 Capt. Franklin arrived at Liverpool, where he was married a second time, and in 1829 had the honor of knighthood conferred upon him. In 1845, Sir John set out on a third expedition with two ships, called the Erebus and Terror, and spent his first winter in a cove between Cape Riley and Beechey Island. After that period many expeditions were dispatched, both from England and America, in search of Sir John, of whom there were no tidings, and not till 1854 did the intelligence reach England that the navigator and his companions had, in all probability, perished in the winter of 1850-1. This intelligence, however, wanted confirmation, and Lady Franklin, who deserves all praise for the intelligent persistency of her efforts, resolved to have the mystery cleared up. Accordingly, a last expedition was fitted out, and the news was, in 1859, at length confirmed by the return of Capt. McClintock, in the yacht Fox, after a persevering search for the lost adventurers. This officer brought with him indisputable proofs of the death of Sir John and the loss of his crew. Several articles belonging to the unfortunate explorers were found at Ross Cairn and Point Victory. At the latter place a record was discovered, wherein it was stated that Sir John Franklin had died 11 June 1847. Other traces were found on the west coast of King William's Island, as the various survivors of the expedition had strayed from each other, perhaps in search of food, or the means of escaping from their dreary and desolate situations. C. F. Hall, the eminent Arctic explorer, returned in September 1869 from a five-years' search for the remains of Sir John Franklin's companions, and brought back about 150 relics of the expedition, purchased from the natives of King William's Land. It remained, however, for Lieut. Schwatka to find the bodies of the Franklin party in his expedition of 1879–80. Franklin was the author of 'Narrative of a Journey to the Shores of the Polar Sea in the Years 1819–22' (1823); 'Narrative of a Second Expedition to the Shores of the Polar Sea in 1825–27' (1828). Consult: McClintock, 'Narrative of the Fate of Sir John Franklin' (1860); Osborn, 'Career, Last Voyage and Fate of Sir John Franklin' (1860); Beesly, 'Sir John Franklin' (1881); Markham, 'Life of Sir John Franklin and the Northwest Passage' (1891); Traik, 'Life of Sir John Franklin' (1896).

Franklin, Samuel Rhoades, American naval officer: b. York, Pa., 25 Aug. 1825. In 1841 he entered the navy as acting midshipman, in 1862 became lieutenant-commander, served in the western gulf blockading squadron (1863), and as assistant to Palmer at New Orleans (1863–4), and was hydrographer to the Bureau of Navigation 1877–80. From 1884 to 1885, when he attained rear-admiral's rank, he was superintendent of the Naval Observatory, and from 1885 until his retirement in 1887 was in command of the European station. He was president of the Washington International Marine Conference (1889), and wrote 'Memoirs of a Rear-Admiral' (1898).

Franklin, William, American colonial governor: b. Philadelphia 1729; d. England 17 Nov. 1813. He was a natural son of Benjamin Franklin (q.v.). He served with the Pennsylvania forces on the Canada frontier, obtained a captain's commission before 1750, in 1754–6 was comptroller of the general post-office, and during a portion of that time clerk of the provincial assembly. He studied law in London and was admitted to the English bar in 1758. In 1762 he became governor of New Jersey. During the Revolution he was a Loyalist, and kept under guard by the patriots from January 1776. In June 1776 he called a meeting of the Colonial

Assembly, then abrogated, for which he was kept prisoner in Connecticut till 1778, when he was exchanged, and later went to England.

Franklin, William Buel, American military officer: b. York, Pa., 27 Feb. 1823; d. Hartford, Conn., 8 March 1903. He was graduated at the United States Military Academy in 1843. In the Mexican war he served on the staff of Gen. Taylor as a topographical engineer; and carried Taylor's orders at the battle of Buena Vista. At the outbreak of the Civil War he was assigned to the command of a brigade in Heintzelman's division. He took part in the battle of Bull Run, served with distinction in the Peninsular campaign and was promoted major-general in 1862. Subsequently he served under McClellan in Maryland and under Burnside at Fredericksburg, was assigned to the Department of the Gulf, under Banks, in 1863; and in 1865 was brevetted major-general in the regular army, but resigned a year later to engage in manufacturing. He was appointed United States commissioner-general to the Paris Exposition in 1899.

Franklin, William Suddards, American physicist and electrical engineer: b. Geary City, Kan., 27 Oct. 1863. He graduated from the University of Kansas in 1887, and the same year was appointed assistant professor of physics there. After studying at Harvard and Cornell and the University of Berlin, Germany, he was appointed in 1892 to the chair of physics and electrical engineering in Iowa State College, remaining there till 1897, when he received his appointment to the same chair in Lehigh University. In 1901 he was a member of the jury of awards of the Pan-American Exposition. He has written 'Elements of Physics' and 'The Elements of Alternating Currents.'

Franklin, a title bestowed upon the English landholders previous to the Norman conquest, who held their lands of the crown free from any feudal servitude. They were bound together by the Frank-pledge, by which the members of each decennary or tithing, which was comprised of 10 families, were held responsible for each other and forced to make reparation if any member committed an offense. In later years they lost their power and dignity, which was usurped by the Normans and became simply wealthy yeomen.

Franklin, Ind., city, county-seat of Johnson County; on the Pittsburg, C. C. & St. L., and the C., C., C. & St. L. R.R.'s; about 75 miles east of Terra Haute, and 16 miles south of Indianapolis. It is in an agricultural section and its chief manufactures are agricultural implements, flour and lumber. Its trade is principally in grain, flour, and boards. It is the seat of Franklin College, founded in 1834 by the Baptist Church. Pop. (1900) 4,005.

Franklin, Ky., city, county-seat of Simpson County; on the Louisville & N. R.R.; about 145 miles southwest of Lexington, and 5 miles from the boundary line between Kentucky and Tennessee. The manufactures are woolen goods, flour, bricks, and lumber. The trade is in the agricultural products of the surrounding country, and the manufactures of the town. It is the seat of the Franklin Military Institute and the Franklin Female College. Pop. (1900) 2,166.

Franklin, La., a town and parish-seat of Saint Mary Parish, 100 miles southwest of New Orleans and 30 miles west of Morgan City, on Teche Bayou, and on the Southern Pacific R.R. It is in the centre of a very fertile district, and as the bayou is navigable for steamers, the town deals in a considerable quantity of cotton, sugar, fruits, etc. There are also several saw-mills located in the town. Pop. (1900) 2,166.

Franklin, Mass., town in Norfolk County, 27 miles southwest of Boston, on the New England R.R. The town also includes the village of Unionville. Dean Academy, an endowed coeducational school, is located here, and the town also has an almshouse, a public library, and six churches. There are manufactories of pianos, straw, woolen, felt and cotton goods, an iron foundry and a canning factory. It was originally a part of the town of Wrentham, but in 1778 was separated and incorporated. The affairs of the community are administered by town meetings. Pop. (1900) 5,017.

Franklin, N. H., a city in Merrimac County, situated at the junction of the Pemigewasset and Winnepesauke rivers, which here unite to form the Merrimac, and on the Boston & M. R.R., 95 miles northwest of Boston. Owing to the abundant water power, numerous mills have located here, among which are paper and pulp mills, machine shops, wood-working shops, hosiery and knitting machine mills, woolen mills and one of the largest needle factories in the world. It is famous as the birthplace of Daniel Webster, and on the farm once owned by him now stands the New Hampshire Orphans' Home. The city owns and operates its waterworks. It was incorporated as a town in 1828 and as a city in 1895. A mayor and council administer public affairs. Pop. (1900) 5,846.

Franklin, Ohio, village in Warren County, on the Great Miami River, and the Miami and Erie Canal, 40 miles northeast of Cincinnati. There are six churches, one high and one primary schools, five paper mills, two wood pulp mills, and three large tobacco warehouses. It was founded by Gen. William Schenck in 1796. Pop. (1900) 2,724.

Franklin, Pa., a city and county-seat of Venango County, 123 miles north of Pittsburg, on the Allegheny River, at the mouth of French Creek, and on the Allegheny V., the Erie, the W. N. Y. & P, and Lake S. & M. S. R.R.'s. The chief business is in oil, as the city is in the heart of the great oil region, but there are also flour mills, planing mills, machine shops, carriage factories, brick works. The city has two beautiful parks and a public library; the streets are provided with sewers and paved with brick. Franklin was first settled in 1753, and was incorporated in 1795. The government is vested in a mayor and council elected annually. Pop. (1900) 7,317.

Franklin, Tenn., town and county-seat of Williamson County, 20 miles south of Nashville, on the Harpeth River, and on the Louisville & N. R.R. The Tennessee Female College, which was established in 1856, and the Harpeth Male Academy are located here, and there are also several public schools and a Masonic Temple. It has flour mills, a furniture

factory and a planing mill, several steam cotton gins, and carriage manufactories. It was the scene of two battles during the Civil War, the first on 10 April 1863, between the Federal forces under Gen. Granger and the Confederate forces under Gen. Van Dorn, the latter being defeated; the second on 30 Nov. 1864, between the forces of Gen. Hood and those of Gen. Schofield, and which is famous as the Battle of Franklin (q.v.). Pop. (1900) 2,180.

Franklin, State of, now Tennessee (q.v.). Fifteen years after the Watauga Association was formed (1769), and when four counties west of the present North Carolina had been organized, with some 10,000 people, that State on request of Congress ceded the district to the United States, giving it two years to accept. The inhabitants, already aggrieved at having no supreme court or militia protection, and being left to fight the Indians and keep public order without help, and now, feeling abandoned to at least two years' anarchy, decided to revolt, set up a State, and ask Congress for admission. On 23 Aug. 1784 deputies from three counties met at Jonesboro, resolved on measures, and issued an address to the people. Each county chose five representatives, which met in convention at Jonesboro in November, but were unable to agree, and adjourned to 14 December. Meantime the alarmed North Carolina legislature established a supreme court and proper officers, and formed the Watauga militia into a brigade, commanded by the leader of the revolt, John Sevier. He advised the convention to accept this redress of their grievances; they refused and made him president, drew up a constitution to be ratified by another convention the following November, and named the new State perhaps at first Frankland; if so, they soon changed it to Franklin, after the philosopher. A governor — Sevier — and a legislature were elected; courts established, sheriffs and justices appointed, etc. For the next three years there were two conflicting governments, each levying taxes, disallowing each other's official acts, and making war on each other. The North Carolina militia invaded the Franklin court-house at Jonesboro, seized the papers, and turned the judge and counsel outdoors; a Franklin mob did the same service to a North Carolina court; the North Carolina commander took the papers by force from Sevier's house, and Sevier gathered a force and recaptured them from his opponent's house. At last, in 1788, the North Carolina party prevailed and put an end to Franklin; Sevier was carried off and tried for high treason; a great Watauga militia gathering attacked the town, rescued him from jail, and carried him back home. Finally the North Carolina legislature sensibly passed an act of oblivion and made Sevier a senator, and in 1790 the lands were ceded to the United States. See U. S.— Westward Movement.

Franklin and Marshall College, located at Lancaster, Pa., was formed in 1852 by the consolidation of Franklin College, founded at Lancaster in 1787, and Marshall College, founded at Mercersburg, Pa., in 1836. Franklin College was organized with a view to meet the needs of higher education in the interior of the State, especially among the Germans, who formed so large a part of the population. Dr. Benjamin Franklin, after whom the college was named, took a deep interest in its welfare, contributed liberally to its endowment, and in his old age made the journey from Philadelphia to Lancaster to be present at its formal opening. Although the college had in its faculty men like Henry E. Muhlenberg, the distinguished botanist, and Frederick V. Melsheimer, the entomologist, and on its board of trustees some of the most prominent men of the commonwealth, its work was that of a first class high school.

Marshall College was founded by the Reformed Church in the United States, when its theological seminary was removed from New York to Mercersburg, to meet the educational requirements of her own communion, and with limited resources accomplished a wonderful work. Among the eminent men in its faculty were its first presidents, Drs. Frederick Augustus Rauch and John Williamson Nevin, and later on Dr. Philip Schaff, all of whom took high rank as philosophers and theologians. The college had a brilliant career, but declined for lack of endowment and pecuniary resources.

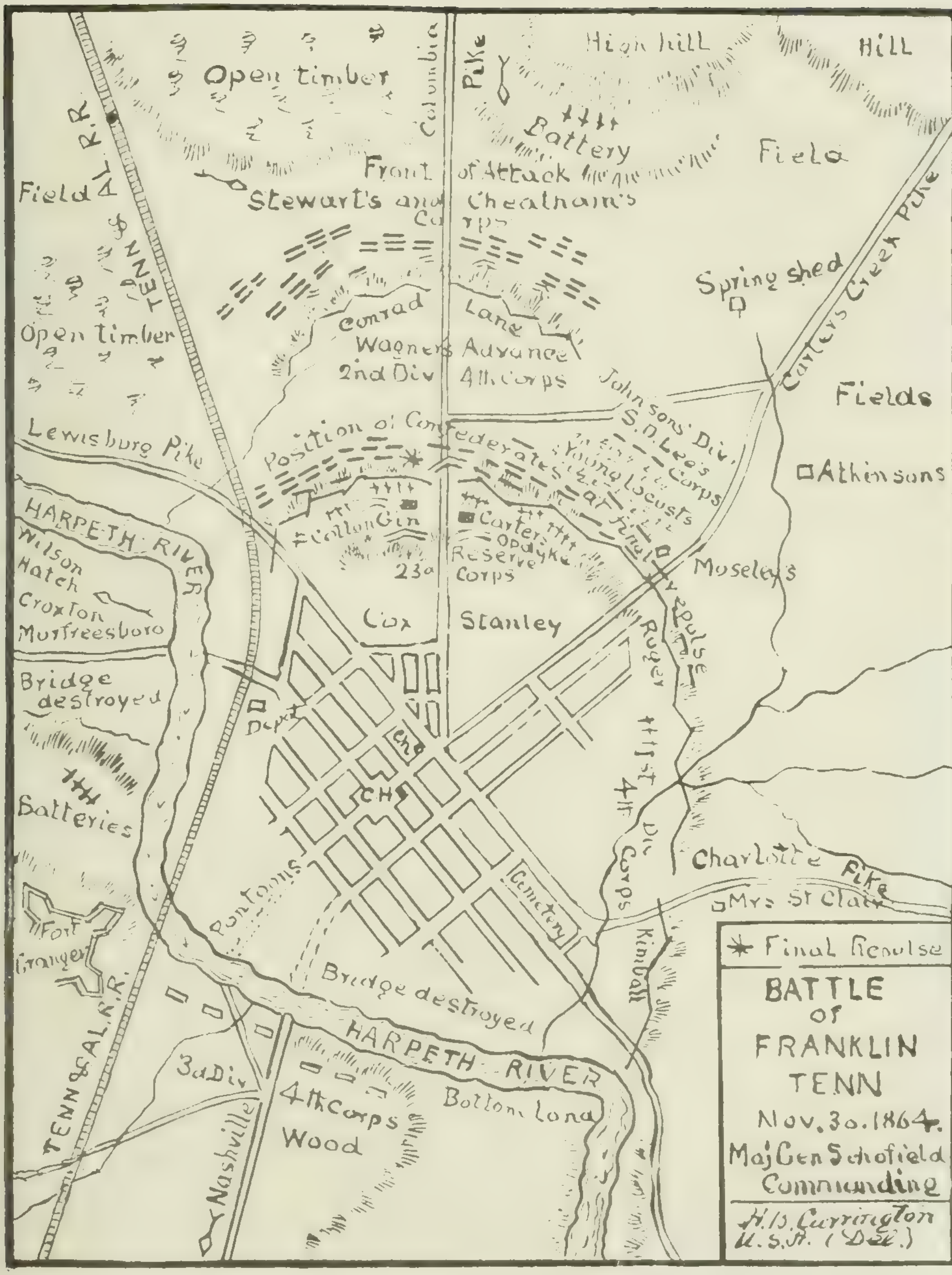
When the two colleges were united, James Buchanan became president of the new board of trustees, and the institution entered upon a prosperous career, although it had to make its way in the face of many obstacles and limitations. Its growth was checked by the Civil War, from the effects of which it but slowly recovered. During the last fifteen or twenty years, however, its growth has been rapid, and it now compares favorably in point of equipment, grade of scholarship, and number of students with its sister colleges in the State of Pennsylvania.

Franklin and Marshall College makes no pretense to be a university. It lays stress upon the college course as a means of liberal education, with sufficient elasticity in the way of electives to make first class preparation for technical or professional study. It confers the degrees of A.B. and Ph.B. for undergraduate work, and A.M. for graduate work, after the completion of the prescribed courses and satisfactory examinations.

The site of the college is exceptionally fine. The principal buildings are: the main building, the halls of the literary societies, the Daniel Scholl Observatory, the gymnasium, the Academy building, the De Peyster Library, and the new Science building, with admirable equipment for physics, chemistry, and biology. The libraries contain altogether about 42,000 volumes. The students in the college proper and the academy number 357, and the faculty 21. This account does not include the Theological Seminary of the Reformed Church, which, although in close proximity to the college, is a separate institution.

John S. Stahr,
President.

Franklin, Battle of. On 12 Nov. 1864 Gen. Sherman turned back from his pursuit of Hood to begin his march from Atlanta to the sea, leaving Gen. Thomas to act on the defensive in Tennessee or to take the offensive in Alabama. Hood was at Florence and Tuscumbia, on the Tennessee River, threatening Nashville, with an army of 44,000 men. Thomas' command, much smaller, was widely distributed from Chattanooga to Nashville. Gen. Schofield was at Pulaski, Tenn., 80 miles south of Nashville. With the Fourth corps under Gen. Stan-



Final Repulse
BATTLE
of
FRANKLIN
TENN
Nov. 30. 1864.
Maj Gen Schofield
Commanding
H. B. Carrington
U. S. A. (Del.)
Open timber
Columbia
Pike
High hill
Hill
Battery
Field
Front of Attack
Stewart's and Cheatham's
Corps
Conrad
Lane
Wagner's Advance
2nd Div 4th Corps
Spring shed
Carter's Creek Pike
Fields
Johnsons' Div.
S. D. Lee's
Corps
Young Locusts
Position of Confederates at final
Athinsons
Lewisburg Pike
HARPETH RIVER
Wilson
Hatch
Croxton
Murfreesboro
Cotton Gin
Carter's
Opdyke
Reserve
Corps
23d
Moseley's
Repulse
Cox
Stanley
Ruger
Bridge
destroyed
Batteries
Depot
Ch
CH
1st
4th
Div
Corps
Charlotte Pike
Mrs St Clair
Cemetery
Pontoons
Fort
Granger
Kimball
Bridge destroyed
TENN & AL. R.R.
3d Div
4th Corps
Wood
Bottom Land
Nashville

ley, a part of the Twenty-third corps, under Gen. Cox, and a division of cavalry. Thomas instructed Schofield to delay Hood, should he advance, until the army could be concentrated and Nashville reinforced. On the 21st Hood moved on Schofield's right. Schofield withdrew from Pulaski on the 22d, reached Columbia on the 24th, and remained there until the 27th, when Hood forced him to withdraw to the north bank of the river. On the 28th Schofield learned that Forrest's Confederate cavalry threatened his line of withdrawal through Spring Hill, 11 miles in his rear, and early on the morning of the 29th all his trains and three divisions of infantry were put in motion for Spring Hill. Stanley led, and arrived at Spring Hill just as Forrest reached it. Stanley checked Forrest and took defensive positions. Hood followed Forrest, and during the night Schofield's entire army passed through Spring Hill, in sight of Hood's bivouac fires, for Franklin, 12 miles distant, which the advance reached before daylight of the 30th. Being unable at once to cross to the north bank of the Harpeth River, Schofield, who was closely followed by Hood, had to fight to save his trains, with a river at his back. He threw up a line of entrenchments, and a division of the Fourth corps under Stanley crossed to the north bank of the river, all those remaining in the works south of it being under command of Gen. Cox. By noon the trains were in, and most of them crossed to the north bank. Not anticipating a general attack, Schofield gave orders for the withdrawal of the troops at sunset. He was mistaken as to the intention of Hood, who had closely followed his rear with Forrest's cavalry, and when Wagner's division, acting as Schofield's rear-guard, had halted and thrown up barricades about 280 yards beyond the main line, Hood rapidly advanced his infantry and ordered a desperate assault to drive the Union forces into the river. Two of Wagner's brigades were on either side of the Columbia road; Opdycke's brigade had come into the main line and was massed 200 yards in rear of the entrenchments. Wagner's orders were "to develop the enemy, but not to attempt to fight if threatened by too strong a force." Hood formed his lines with celerity on either side of the Columbia pike, Cleburne's and Brown's divisions of Cheatham's corps on the east and west sides of the road respectively, in two lines of battle. When within 400 yards of Wagner's line, at 3.30 P.M., the charge was ordered and, with a wild shout, they rushed forward. Wagner was enveloped on both flanks and fiercely attacked in front, the Confederates rushed over his barricades, and his men gave way in the greatest disorder, closely pursued by the exultant enemy. When within 100 yards of the main line the Union artillery and infantry opened fire. Cleburne, who was leading his division, was shot dead, great gaps were made in the ranks, but the line pressed on, carried the centre of the Twenty-third corps' line for the length of a brigade, went over the works, captured two batteries and many prisoners, reached an inner line of intrenchments, 68 yards in rear of the main line, and here they were checked. Col. Opdycke, who had massed his brigade in rear, when he saw Wagner's men falling back in disorder, and that the works in front had been captured, ordered his men forward. Deploying as they advanced, they rushed upon the Confederates, and a desperate hand-to-hand encounter took place, resulting in the retreat of the enemy to the outer line of works, the capture by Opdycke of nearly 400 prisoners and 9 battle-flags, and the recovery of the captured batteries. Gen. Thomas says Opdycke's prompt action "saved the day." Meanwhile the battle had extended to the right and left, involving all of the Twenty-third corps and the left brigade of Kimball's division. The Confederates reached the works in many places, but were unable to carry them. On both sides the fighting was most gallant. At midnight the Union army crossed to the north bank of the river and marched to Nashville.

The Union army engaged at Franklin, not including cavalry, numbered about 23,000 men, of whom 189 were killed, 1,033 wounded, and 1,104 missing. Of this loss 1,241 were in Wagner's division. The Confederates engaged numbered about 22,000. There are no official reports of Hood's losses, but Schofield reports that 1,750 were buried on the field, 3,800 were disabled and placed in hospital, and 702 captured, an aggregate of 6,252, to which must be added the slightly wounded, probably 2,000. Consult: 'Official Records,' Vol. XLV.; Cox, 'Battle of Franklin' 'The March to the Sea, Franklin and Nashville'; The Century Company's 'Battles and Leaders of the Civil War,' Vol IV.

E. A. CARMAN.

Franklin College, a coeducational institution in Franklin, Ind.; founded in 1834 under the auspices of the Baptist Church; reported in 1902: Professors and instructors, 10; students, 200; volumes in the library, 12,300; productive funds, $207,000; grounds and buildings valued at $75,000; income, $14,500; number of graduates, 305; president, Rev. W. T. Stott, D.D.

Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts. A famous school in Philadelphia, established in 1824, which now embraces schools in mechanical and architectural drawing, machine design, naval architecture, etc. The objects of the institute are obtained by means of a journal (begun in 1826), lectures, libraries, reports, exhibitions and school instruction. The library now contains 55,000 volumes and 38,500 pamphlets. The institute grants medals, premiums and certificates for mechanical inventions. The Institute building is located at 15 South 7th Street, Philadelphia.

Franklinism. See ELECTRICITY.

Frank'linite, a native oxide of zinc, manganese and iron, containing these metals in rather widely varying proportions. It crystallizes in the isometric system with octahedral habit, and also occurs in massive and granular forms. It is opaque, slightly magnetic, and iron-black in color, commonly with a metallic lustre. Its hardness varies from 5.5 to 6.5, and its specific gravity from 5.1 to 5.25. In the United States it occurs in considerable quantity in the neighborhood of Franklin Furnace, N. J., taking its name from the locality, where it is mined as an ore of zinc, its manganese and iron being melted into "spiegeleisen," an alloy used in the manufacture of Bessemer steel.

Franks, SIR **Augustus Wollaston,** English archæologist: b. Geneva, Switzerland, 1826; d. London 22 May 1897. He was graduated at Cambridge University in 1849; became an as-

sistant in the British Museum in 1851; and served as keeper of the Department of British and Mediæval Antiquities for many years. He was knighted in 1888; and was president of the Society of Antiquities from 1892 till his death. His publications include 'Recent Excavations and Discoveries on the Site of Ancient Carthage' (1860); 'Guide to the Christy Collection of Prehistoric Antiquities and Ethnography' (1868); 'Catalogue of a Collection of Oriental Porcelain and Pottery' (1876); etc.

Franks ("Spearmen"), **The.** In the 3d century A.D. (the name first appears in 240, under the Emperor Gordian), the scattered Teutonic tribes north and east of the middle and lower Rhine, in the present Westphalia, Hesse, Gelderland, etc., united in a loose confederacy; very probably compacted by the ancestor of the Meroving family, to whom the Franks clung so loyally and even stupidly for centuries. The tribes themselves were known from the early empire: Ampsivarii, Attuarii, Batavi, Bructeri, Chamavii or Gambrivii, Chatti, Cherusci, Sali, Sigambri, Usipetes, etc. In 253 under Valerian they raided Belgic Gaul, and half a century later had permanently settled south of the lower Meuse in Brabant. They are early distinguished as Salian and Ripuarian Franks: the former (from their chief tribe, perhaps originally on the Isala or Yssel) on the lower Rhine; the latter (*ripa*, bank) on both banks of the middle Rhine. The Salians, after heavy defeats by the Romans, became their allies and wardens of the marches; but when the pretender Constantine withdrew the Roman garrisons in 406 for his attempt on Italy, they flooded central Belgium, and Colonia Agrippina (Cologne) shortly fell into their hands. By 450 they had reached the Moselle and the Somme, or Luxemburg and northwest France; but still acknowledged Roman sovereignty. They sent forces to help the Romans against Attila at Châlons; but when the Huns had retreated from the fortresses whence they had expelled the Romans,— Trier, Mainz, Metz, etc.,— the Franks occupied them and the lands on the Rhine and Moselle instead of the Romans. The Salians now held the territory from the Scheldt to the Somme and Meuse, or most of Belgium and a little of France; the Ripuarians from the Meuse to the Rhine, and the lands along that river from the Lippe to the Lahn. They were still pagans; backward in the arts of war; had no political union or common head, though their chiefs all claimed Meroving descent; and were credited with being treacherous and perfidious even beyond barbarian wont, which their history makes probable.

When the Western Empire fell, the Rhone and Saône valleys were occupied by a Burgundian kingdom; central and northern France by a Roman province with no one to obey; below which was the great Visigothic kingdom of Euric, taking in south France and nearly all the Spanish peninsula. Five years later (481) a Salian prince of the upper Scheldt named Chlodovech (Latinized Clovis) acceded, and in 485 fell on the Roman province in alliance with other princelings. In three years he had conquered it, making Gaul to the Loire and Brittany a Frankish possession; refusing to share the spoil with his allies, he attacked and subjugated all the Ripuarians, slaying every Merovingian prince he could seize, to exterminate all rivals. In 492 he married Clotilda, the Catholic niece of the Burgundian king. In 496 he subdued the Alemanni, and Frankish settlers founded Franconia. On returning from this campaign he was baptized a Christian, in the Athanasian creed; and in a single generation the entire Frankish body, now consolidated into one, renounced paganism. He then conquered nearly all Visigothic Gaul. But Burgundy was too strong for him. He died in 511. The chance of Chlodovech becoming an Athanasian instead of an Arian had the most important consequences: alone of all the barbarian conquerers of Rome, his subjects were in religious sympathy with him, and his work endured, while the Arian kingdoms crumbled to pieces. This also began the career of the Frankish monarchy, for centuries, as the champion of the Church, helping it and helped by it.

Chlodovech began the practice of dividing the kingdom among his sons, which his successors followed; again and again death or the strong hand united the realms, again a legacy would divide them; and the records of the ferocious, half decrepit, perfidious Merovingians are the blackest in all European history for unredeemed wickedness and unprogressive anarchy. Scarce one of them for a century lived to be 40, and scarce one showed any gleam of statesmanship to justify his atrocities or his even worse weakness. At last in 613 the dominions — which had generally followed the fourfold divisions of Austrasia, Neustria, Burgundy, and Aquitaine — were united for a seeming finality, but the Merovingian kings ceased to have any but a nominal sovereignty. The great provincial governors, in the anarchy, had made their offices hereditary; the officers of state likewise — chamberlain, keeper of the seal, etc. Of these the mayors of the palace became the *de facto* rulers; keeping the kings as puppets, but making them live as country gentlemen, only attending court functions annually, in a farm-cart and with long hair. This mayoralty in Austrasia fell into the hands of one of the most wonderful families of the world, the Karlings or Carlovingians, who mostly held possession of it for a century, till one of them became king; and later the mightiest of them, Charlemagne, became emperor of the Romans in a revived empire. Pepin, or Pippin of Landen, "the Elder," was the first, dying 639; then his son Grimwald, murdered 656; the latter's sister married the son of Arnulf Bishop of Metz; and their son was Pepin the Younger or Pepin of Heristal, who, after 30 years of anarchy and partition and reunion following Grimwald's death, finally and forever reunited the Frankish realms by a crushing defeat of the allied forces of Neustria and Burgundy at the battle of Testry, 687. His son, Charles Martel (Hammer), who held power 717–41, carried civilization at the sword's point among the Germans, and in 732 routed a great Saracen army at Poitiers, saving France from the Mussulman. His son Pepin the Short, after 10 years of mayoralty, deposed the last driveling Meroving and ascended the throne. Pepin's son Charles (Carolus Magnus, Charlemagne, perhaps with a confusion of the title with the name Carloman), acceded in 768. As warrior, statesman, and lawgiver, he stands among the foremost of all time. The Frankish realm as such attained by far its greatest extension under him — though it is incorrect to say, as is usual, that his work

perished with him, for the pieces of his realm never went back to their old anarchy. He ruled a vast congeries of races, from north Spain to north Germany, and from the Hungarian plains to the English Channel; and he brought them all under the reign of law and Christianity, inheritors of the memories and civilization of Rome. In 800 he crowned the career of the Franks begun by Clovis, becoming secular head of a Holy Roman Empire, of which the Pope was the spiritual head. Whether it was well judged or beneficial to the world, historians are still divided. The history of Charlemagne's successors is not the history of the Franks: after this they have become merged in a wider aggregation.

The Frankish dominion was the conduit through which the treasures of Rome, political, social, and ecclesiastical, were given to the world. Roman law, Roman literature, and the Christian religion were forced on the barbarians through the Franks: that Europe is what it is, we have to thank them first of all. The best modern compendium is Oman's 'History of the Dark Ages' (1901).

Franz, fränts, **Robert,** German composer: b. Halle 28 June 1815; d. Berlin 24 Oct. 1892. He studied under Schneider at Dessau 1835–7, and in 1843 published his first set of 12 songs, which won the warm praises of Schumann, Mendelssohn, Liszt, and other masters. From then till 1868 he held various appointments at Halle. He published over 250 songs with pianoforte accompaniments, a Kyrie, and several chorales and four-part songs, besides arrangements of the vocal masterpieces of Bach and Handel. Franz's best songs rank with those of Schubert and Schumann.

Franz-Josef Land, fränts'-yō'zĕf-länt, an Arctic archipelago, north of Nova Zembla, extending, so far as it has yet been explored, between lat. 80° and 83° N. It consists of two large masses of land, Wilczek Land to the east, and Zichy Land to the west, separated by Austria Sound, and Rawlinson Sound. Between these two sounds lies Crown Prince Rudolf Land, while to the north of this again comes Petermann Land, and to the northwest King Oscar Land. The southern shores are deeply indented with fjords; and the whole archipelago, which rises into isolated flat-topped or dome-shaped mountains of basalt, 5,000 feet high, is sheeted with ice. Owing to the open water round its shores in summer, and the comparative abundance of its animal life — bears, walruses, foxes, and numerous birds occurring — Franz-Josef Land is regarded by many experienced Arctic explorers as the most favorable base whence to make an attempt to reach the North Pole. The archipelago was discovered and partly explored by Payer and Weyprecht in 1873–4; its southern shores were explored by Leigh Smith in 1880–2, and much of it by the Jackson-Harmsworth expedition in 1895–6. See POLAR EXPLORATION.

Franzensbad, fränt'sĕns-bät, **Egerbrunnen,** ā'gĕrbroon-nĕn, or **Kaiser-franzensbad,** Bohemia, a celebrated Austrian watering-place, about three miles north of Eger, with which it is connected by a fine avenue. It is situated amid low bare hills, and consists of four rectangular streets lined with trees. The mineral springs here were known in the 16th century, and even at that time the waters were made up in bottles to be sent to a distance. It was selected as a watering-place in 1793 by the Emperor Francis II., from whom it received its present name. The bathing establishment consists of an irregular building erected over the springs with a long colonnade extending to the Kurhaus, where the visitors assemble, and the balls and concerts are given. The springs, 12 in number, are alkaline, taline, chalybeate, and are very efficacious in cases of anæmia, dyspepsia, catarrh of the bowels, uterine disorders, etc. The mud baths of Franzensbad are much used by those suffering from gout, rheumatism, skin diseases, etc. Pop. (1890) 2,330.

Fra'ser, Agnes, («FRANCES MAC NAB»), English traveler and writer: b. Halstead, Essex, 7 Dec. 1859. She studied art in London 1882–4, and has since traveled extensively in Algiers, Norway, British Columbia, Morocco, and South Africa. She has published: 'No Reply' (1888); 'Relics: Fragments of a Life' (1893); 'On Veldt and Farm in Bechuanaland, Cape Colony, the Transvaal, and Natal' (1897); 'British Columbia for Settlers' (1898); 'A Ride in Morocco among Believers and Traders' (1902).

Fraser, Alexander Campbell, Scottish philosophical writer: b. Ardchattan, Argyleshire, 3 Sept. 1819. He was a lecturer on mental philosophy in the New College, Edinburgh, 1846; editor of the 'North British Review' (1850–7); professor of logic in Edinburgh University 1856–91. His principal productions are: 'Essays in Philosophy' (1856); 'Rational Philosophy' (1858); a memoir of Bishop Berkeley, with a collected edition of his works (1871–90); an annoted edition of Locke's 'Essay on Human Understanding' (1894); 'Philosophy of Theism' (1898), etc.

Fraser, Augusta Zelia Webb («ALICE SPINNER»), Scottish novelist. She was married to Affleck Fraser 1889. She has published over the pseudonym «ALICE SPINNER,» 'A Study in Color'; 'Lucilla'; 'A Reluctant Evangelist.'

Fraser, Charles, American painter; b. Charleston, S. C., 20 Aug. 1872; d. there 5 Oct. 1860. He studied law, was admitted to the bar in 1807, but withdrew from practice in 1818, and acquired, particularly in the South, a considerable reputation as a miniature-painter. His sitters included Lafayette (1825) and most prominent South Carolinians for 50 years. He also painted interiors, landscapes, genre, and still-life scenes, and historic subjects. An exhibition of his works at Charleston in 1857 comprised 313 miniatures and 139 other canvases in oils. Publication: 'Reminiscences of Charleston' (1854).

Fraser, MRS. **Hugh.** See FRASER, MARY CRAWFORD.

Fraser, James, English prelate: b. Prestbury, Gloucestershire, 18 Aug. 1818; d. Manchester 22 Oct. 1885. He was educated at Lincoln College, Oxford, took orders in the English Church and was rector at Cholderton, Wiltshire, 1847–60; and of Ufton Newet, Berkshire, 1860–70. In the year last named he became bishop of Manchester, in which position he gained the approbation of churchmen and nonconformists alike. Under his administration the diocese made a most remarkable advance.

Bishop Fraser was greatly interested in educational matters and visited the United States and Canada in 1865 as a commissioner of education, subsequently publishing a 'Report on the Common School System of the United States and of Upper and Lower Canada' (1866). A bronze statue of Bishop Fraser stands in the square before the Town Hall of Manchester, and in the Fraser Chapel of the Cathedral of Manchester is a recumbent statue in marble of the much beloved prelate. See Hughes, 'Memoir of Bishop Fraser' (1887).

Fraser, Mary Crawford (MRS. HUGH FRASER), English novelist: b. Rome. She is a sister of F. M. Crawford (q.v.), the novelist, and was married to Hugh Fraser, English minister to Japan, who died in 1894. She is the author of 'The Brown Ambassador' (1895); 'Palladia' (1896); 'A Chapter of Accidents' (1897); 'The Looms of Time' (1898); 'A Diplomatist's Wife in Japan' (1899); 'The Customs of the Country: or Tales of New Japan' (1899); 'The Splendid Porsenna' (1899), etc.

Fraser, Simon. See LOVAT, TWELFTH LORD.

Fraser, William Alexander. Canadian author: b. Pictou County, N. S., 24 March 1859. He traveled widely and became a mining engineer, but subsequently turned his attention to writing. He has contributed much to English and American magazines; published an interesting collection of animal stories, 'Mooswa and Others of the Boundaries' (1900), and also 'The American Animal Book,' and 'The Outcast' (1901).

Fraser River, the principal river in British Columbia, rising in the Rocky Mountains, in lat. 53° 42'.; lon. 119° W. It flows northwest for about 270 miles, then turns south, and after a total course of over 700 miles falls into the Gulf of Georgia, in lat. 49° N. Gold is found both on the Fraser and its affluents. Its principal affluents are the Thomson, Quesnelle, and Stuart rivers.

Fraserville, or **Reviere du Loup,** rē-vē-ār dü loo, Canada, a town and county-seat of Temiscouata County, Quebec, on the south shore of the St. Lawrence at the confluence of the Reviére du Loup, 116 miles below Quebec. It is on the Intercolonial Railway and is the terminus of the Temiscouata Railway. Its permanent population is almost entirely French Canadian. It has a good trade and manufactories of pulp, leather, lumber, furniture, iron products and woollens. There are three churches (2 Angelican and 1 Catholic), a convent, hospital, and collegiate institute. It has a creamery, banks, and newspapers (French), and is a popular summer resort. Pop. (1901) 4,569.

Fraternal Insurance. See INSURANCE, FRATERNAL.

Fraternal Societies in America. A fraternal society is defined as a corporation or voluntary association organized and carried on for the sole benefit of its members and their beneficiaries. It has no capital stock and is not operated for profit. Every such society must have a representative form of government, and is supposed to operate on the lodge system, with a ritualistic form of work for the meetings of the lodges or other designated subordinate bodies. It has power to adopt its own constitution, by-laws, rules and regulations for the orderly conduct of its affairs, and in general terms may manage its internal interests as it may deem best. Although the American fraternities have the same basis as the friendly societies (q.v.) of England and Scotland, they are a purely American institution, organized without reference to, and at the outset of their career, in entire ignorance of the fact that the same system was in successful operation elsewhere. At the present time the laws governing the fraternal system are in a state of transition, and as the fraternal societies are the creatures of, and governed by the laws of the different States, any change in those laws will necessarily change or modify the system as at present operated.

There are two representative bodies, claiming to act for, and represent a large constituency among the fraternal associations. The National Fraternal Congress, organized in 1886, represents the larger number of leading societies. From its official reports it appears to aim at eventually securing the adoption of a uniform law throughout the United States and Canada, defining as fraternal society, as above expressed, with the addition, that every society shall pay a death benefit on the death of a member, and may pay disability payments, resulting from accident, disease, or old age. During the years 1900 and 1901 the Congress made a vigorous effort to secure the passage of a uniform bill in the legislatures of all the leading States, restricting the benefits, coupled with a provision requiring all the newer organizations to charge adequate rates, but allowing the older societies to continue their low rate assessment system. This action was bitterly opposed by the minority of the Congress and by a still larger number of other associations, that were not affiliated with the Congress. The result of this opposition was the defeat of the proposed law in every State where a contest was made.

The outside societies that participated in this contest, feeling the need of a union, for mutual protection thereafter, immediately after the contest was ended met together and in March 1901, organized the Associated Fraternities of America, with the avowed object of opposing any further changes in the laws of the different States until public sentiment was ripe for the adoption of a uniform law on the basis of the largest liberty to each society in the matter of benefits, provided adequate rates are charged therefor. This dissension among the fraternal societies induced the convention of the insurance commissioners of the different States to formulate a proposed law for the government of fraternal societies, containing many new and startling features.

All the early fraternal associations collected their contributions from their members by means of assessments, the rate of which, except in two instances, was graded according to age at entry, and each member was required to pay such a number of assessments each month as might be needed to meet the death losses. As these older organizations advanced in years, their death losses necessarily increased in number, and with increased death losses the number of assessments each month also increased. During this period many new societies were organized on the same system and while young, naturally had a low death rate, and a low mortality cost per member. Being much cheaper they naturally attracted members from their

predecessors until they were displaced in popular favor by other new creations on the same plan. Whatever differences of opinion may now exist among fraternalists as to the need of the systems at the present time, they all agree that the old assessment system has been a failure, and should be superseded by rates based on the recognized mortality tables. The newer organizations profited by the experience of the older societies, and generally started with higher rates, and this fact has made it much easier for them to provide for their deficiencies. A large number of the younger organizations are, and for some years have been, charging adequate rates, and the protection they furnish is as safe as the insurance supplied by any insurance company.

The real basis of the fraternal system in America is the fraternal bond of union, uniting the members together in a common cause for mutual beneficial and protective purposes. The lodge system requires meetings of the members at least once a month, and therefore directly tends to draw the members closer together. Every member thus participates in the work of the organization and the emulations aroused among the different lodges naturally produces the best results at the least outlay. Bread cast upon the waters will return, and it is the act of casting that produces that wonderful change in the human heart, which constitutes the return. A mother is fonder of her offspring than the father, and both parents love a crippled child more than the sturdy members of the flock, and the reason is the same. The mother suffers more and bears more than the father, and both do more for the cripple than for the healthy child. No one ever did a good deed, or thought to do a good act without feeling the better for it, and thus no person ever did or can participate in the good work that the various lodges of the fraternities are engaged in without growing to love the work and the organization which does the work. This ennobling influence upon the membership is not by any means the least of the many blessings conferred upon the American people by the fraternal system. This same influence naturally impels the members to labor without compensation for the growth and prosperity of the organization and thus at a low cost produce results beyond the dreams of avarice to the insurance companies.

Every society is required to have a representative form of government and is governed by its constitution and laws, as enacted, or from time to time amended, by the constituted authorities. Its constitution and laws therefore constitute the contract between the members in their relations to the society. The protection furnished by such societies is not insurance in the ordinary sense, in which that word is understood and used. No society can issue a certificate in favor of a creditor of the member and the benefits furnished under the certificate cannot be attached for the debt of the member. The beneficiaries are limited to husband or wife, affianced husband, or affianced wife, or, some heir, blood relative, or dependent of the member. In insurance anyone having an insurable interest in the life of the policy holder may be named as beneficiary while under a fraternal certificate the beneficiary is limited by the bonds of affection and duty. In the one case a beneficiary has a vested interest in the policy and it cannot be changed without her consent, while in the other the beneficiary has no vested rights whatever until the claim matures; and the member may have his certificate changed in favor of another beneficiary without her knowledge or consent.

Among the prominent large fraternal societies in the United States are the Odd Fellows, founded in 1819; Knights of Honor 1873; Knights of Pythias 1877; and Royal Arcanum 1877. The insurance paid by these varies from $500 to $3,000. There are numerous other societies conducted on the same principle. According to the reports of the supreme bodies of these organizations for 1904, the membership of the principal fraternal organizations in the United States and Canada was as follows:

Odd Fellows	1,341,375
Freemasons	1,011,655
Modern Woodmen of America	700,359
Knights of Pythias	594,883
Ancient Order of United Workmen	423,015
Knights of the Maccabees	375,000
Improved Order of Red Men	355,662
Royal Arcanum	303,597
Foresters of America	299,081
Independent Order of Foresters	224,000
Woodmen of the World	217,128
Ancient Order of Hibernians	193,832
Benevolent and Protective Order of Elks	190,000
Order of Eagles	165,000
Junior Order of United American Mechanics	130,977
Ladies of the Maccabees	149,060
Knights of the Modern Maccabees	127,000
Knights of Columbus	122,645
Ladies Catholic Benevolent Association	87,400
Tribe of Ben Hur	85,267
Knights and Ladies of Honor	76,761
Court of Honor	70,426
Knights of the Golden Eagle	69,385
National Union	69,000
Improved Order of Heptasophs	62,860
Catholic Mutual Benefit Association	58,035
Protected Home Circle	56,000
Knights of Honor	52,600
Brotherhood of American Yeomen	47,025
Order of B'rith Abraham	46,234
Order of Gleaners	46,000
United Order of American Mechanics	42,691
New England Order of Protection	39,098
Ancient Order of Foresters	38,898
Sons of Temperance	34,789
Independent Order of B'nai B'rith	31,500
Catholic Benevolent Legion	28,000
Knights of Malta	28,000
Smaller organizations	284,541
Total	8,278,779

All the older associations operate on what is known as grand jurisdictions, consisting of representatives elected by the subordinate lodges within the limits of the grand jurisdiction. It in turn sends delegates to the supreme body, which is the highest authority in the organization. As a general rule the supreme body assumes all liability for death or disability payments that are permanent in their nature, and the subordinate lodges assume and pay the sick or other temporary disability benefits. Each member pays his share of all benefits through the local lodge, of which he is a member, the dues going to the supreme office, being remitted direct, and not through the grand jurisdiction. As a rule the grand jurisdiction covers a State, and has supervision over the growth and general management of all the lodges within its territory. Of late years the tendency has been to do away with the plan of grand jurisdictions and have the supreme body composed of delegates elected either directly by the lodges or by districts composed of a number of lodges. The officers are usually elected by the supreme body, but in some cases are elected by a direct vote of the members.

To sum up in a word: a fraternal society is a brotherhood of members, bound together by its fraternal bond of union. It is organized and carried on for the sole benefit of its members and their beneficiaries. It operates on the lodge system, and uses a ritual in the meetings of its lodges and the initiation of its new members. It has a representative form of government, in which the management is responsible to the members for the faithful performance of their duties. It is governed by a constitution and laws enacted by the representatives of its members, and it furnishes its members, in all the States, with protection in case of death, and in many of the States with protection in case of disability resulting from illness, accident and old age, after the expectancy of life, and in some of the States with still more liberal benefits. See INSURANCE, FRATERNAL, and the articles on the different fraternal organizations.

FREDERICK GASTON,
President the Grand Fraternity.

Frater'nities, religious societies for pious practices and benevolent objects. They were often formed during the Middle Ages, from a desire of imitating the holy orders. From the 12th to the 15th century nothing was considered more meritorious than to form and belong to such orders. The laity, who did not wish to pronounce the monastic vows, entered into associations in order to gain some of the advantages of the religious even in their worldly life. These societies were at first formed without any ecclesiastical interference, and on this account many of them, which did not obtain or did not seek the acknowledgment of the Church, had the appearance of separatists, which subjected them to the charge of heresy. The pious fraternities which were formed under the direction of the Church, or were acknowledged by it, were either required by their rules to afford assistance to travelers, to the unfortunate, the distressed, the sick, and the deserted, on account of the inefficiency of the police, and the want of institutions for the poor, or to perform certain acts of penitence and devotion. Of this description were the Fratres Pontifices, a brotherhood that originated in Tuscany in the 12th century, where they maintained establishments on the banks of the Arno, to enable travelers to cross the river, and to succor them in case of distress. A similar society was afterward formed in France, where they built bridges and hospitals, maintained ferries, kept the roads in repair, and provided for the security of the highways. A bridge of 18 arches over the Rhône at Avignon, built by St. Bénézet in 1177, and another of 22 arches over the same river at Pont St. Esprit, built between 1265 and 1309, were among their greatest achievements in bridge-building. They gradually amassed great wealth by alms and gifts. In 1519 they were secularized on account of the abuses that had crept into the order.

Similar to these were the Knights and Companions of the Santa Hermandad in Spain; the Familiars and Cross-bearers in the service of the Spanish Inquisition; the Calender Brothers in Germany; the Alexians in Germany, Poland, and the Netherlands, etc. The professed object of the Alexians was to visit the sick and imprisoned; to collect alms for distribution; to console criminals, and accompany them to the place of execution; to bury the dead, and to cause masses to be said for those who had been executed, or for persons found dead. They derived their name from Alexius, their patron saint, and were at first principally composed of persons from the lower classes of the people in the Netherlands. They were afterward increased by the addition of the female branch, the Black Sisters. Although lay brothers they had houses, and formed their order into two provinces under an ecclesiastical government. They still exist, in the societies for burying dead bodies, in Antwerp, Utrecht, and Cologne. The Brothers of Death, of the order of St. Paul, were dressed in black, like the Alexians, and were distinguished by a death's head on their scapulary. They were suppressed by Pope Urban VIII.

There were also Gray Penitents (an old fraternity of an order existing as early as 1264 in Rome, and introduced into France under Henry III.), the black fraternities of Mercy and of Death; the Red, the Blue, the Green, and the Violet Penitents, so called from the color of their cowl; the divisions of each were known by the colors of the girdle or mantle. The fraternity of the Holy Trinity was founded at Rome in 1548 by Philip de' Neri for the relief of pilgrims and the cured dismissed from the hospitals. The Brothers of the Christian Schools are a fraternity founded near the end of the 17th century, the statutes of which were approved by Benedict XIII. Their labors have been of great service in the cause of elementary and secondary education in France, though their work is not confined to France but extends over a large part of the world, including Belgium, North and South America, and England. They take religious vows, wear a suit of clerical dress, and always work in pairs. In Ireland there is a body of Christian Brothers modeled on the French one, the first of its schools having been opened at Waterford in 1804. Their schools have spread over Ireland, and their system of education has received the approval of various Royal Commissions.

The Brothers of Common Life, founded at Deventer in Holland by the celebrated theologian, Gerald Groot, toward the end of the 14th century, and formally approved by Gregory XI. in 1376, were a fraternity which performed great services to learning, especially theological learning. From Holland they spread rapidly over Germany, and increased so greatly in numbers that 500 houses belonged to the order in 1460. The Roman Catholic Church is indebted to it for a text of the Latin version of the Bible by St. Jerome, most carefully prepared by a collation of the most ancient manuscripts. This text was consulted as an authority by the editors of the Bible prepared at the command of Sixtus V. The same order prepared some texts of the Christian fathers.

The Brothers of Charity are another fraternity whose hospitals are found in the principal cities. It was founded by St. John de Dieu in Spain in 1540. Much better known in Great Britain are the Sisters of Charity (called also Gray Sisters, Daughters of Charity, Sisters of St. Vincent de Paul), a Roman Catholic order founded in 1634 at Paris by St. Vincent de Paul for the purpose of nursing the sick in hospitals. The sisters take vows of poverty, chastity, and obedience, besides a vow binding themselves to serve the sick. Besides conducting hospitals and nursing, they sometimes undertake the manage-

ment of poor schools. They attend the sick of every nation and religion. There is also a body of Irish Sisters of Charity, separate from the one just mentioned. See ORDERS, RELIGIOUS.

Fraternities, College. See GREEK-LETTER SOCIETIES.

Fraticelli, frăt-ĭ-sĕl'ĭ, a name applied to several heretic sects in the Middle Ages. They were generally opposed to existing ecclesiastical and social order and were similar to the Brethren of the Free Spirit, Beghards and other sects. They had no fixed place of residence. In 1260 to 1300 the Fraticelli made considerable progress and attracted more or less attention in northern Italy. They declared the existing Church as in a state of apostasy and looked upon poverty as an absolutely essential condition.

Fratricellians. See FRATICELLI.

Fraud, in law, all deceitful practices in defrauding or endeavoring to defraud, another of his known right, by means of some artful device, contrary to the plain rules of common honesty. It is condemned by the common law, and punishable according to the offense. All frauds and deceits for which there is no remedy by the ordinary course of law are properly cognizable in equity. Where a fraud can be clearly established, courts of law exercise a concurrent jurisdiction with courts of equity. Wherever fraud or surprise can be imputed to, or collected from, the circumstances, equity will interpose and grant relief against it. Where a person is party to a fraud, all that followed by reason of that fraud shall be said to be done by him. A party prejudiced by a fraud may file a bill in equity for a discovery of all its circumstances. Mere inadequacy of price alone is not a ground for a court to annul an agreement; but if there be such inadequacy as to show that the person did not understand the bargain he made, or was so oppressed that he was glad to make it, knowing its inadequacy, it will show a command over him which may amount to a fraud. If a person be fraudulently prevented from doing an act, equity will consider the act as done; and equity also relieves against bargains made under misconception of rights. In treaties, concealment of a material fact by one of the parties, in order to keep the other in ignorance, whereby to profit, is a gross fraud, and the contract will be set aside in equity. Constructive or legal fraud is applied to such acts or contracts as, though not originating in any actual evil design or contrivance to perpetrate a positive fraud or injury upon other persons, yet by their tendency to deceive or mislead other persons, or to violate public or private confidence, or to impair or injure the public interest, are deemed equally reprehensible with actual fraud, and are prohibited by law, as within the same reason and mischief as acts and contracts done *malo animo*. Gross criminal frauds are punishable by way of indictment or information. Frauds are not indictable at common law unless they be such as affect the public — as vending unwholesome provisions, or using false weights or measures; or by way of conspiracy; or unless they affect the crown or the administration of justice. See FRAUD, STATUTE OF; FRAUDULENT CONVEYANCES.

Consult: Browne, 'Construction of the Statute of Frauds' (1895).

Frauds, Statute of. Perhaps one of the most important statutes ever enacted in England or the United States was the Statute of Frauds (29 Charles II. ch. 3). It was passed in the year 1673. Its object is stated to be the "prevention of frauds and perjuries," and its effect is to make writing essential to the validity of many contracts or transactions. The most important sections are those relating to contracts; namely, the 4th and the 17th, almost every word of which has been the subject of numerous decisions. It is provided by the 4th section that no action shall be brought on the contracts therein mentioned unless the agreement or some note or memorandum thereof, shall be in writing and signed by the party to be charged therewith, or some other person thereunto by him lawfully authorized. The contracts referred to are the following: (1) Any special promise by an executor or administrator to answer damages out of his own estate; (2) any special promise to answer for the debt, default, or miscarriage of another person; (3) any agreement made upon consideration of marriage; (4) any contract or sale of lands, tenements, and hereditaments, or any interest in or concerning them; and (5) any agreement that is not to be performed within the space of one year from the making thereof. This section, however, does not make the contract null and void, but only unactionable. The 17th section has reference to sales of goods for the price (or value) of £10 and upward, which are "not allowed to be good" unless some memorandum of the bargain has been made in writing, or unless the buyer shall accept part of the goods so sold, and actually receive the same, or give something in earnest to bind the bargain, or in part payment. In the statutes of the American States the principal alteration made in these terms is by the specification of a different sum of money. The sum usually established is $50, but in some of the States it is $30, or $40. The importance of this statute has been so fully recognized in this country that it has been substantially re-enacted in every State in the Union, and in some of them its provisions have been made still more comprehensive and stringent. See FRAUD.

Fraudulent Conveyances, in law, a fraudulent conveyance is a conveyance the object, tendency, or effect of which is to defraud another not a party to such a conveyance, or the intent of which is to avoid some debt or duty due by or incumbent on the party making it. Conveyances of this character are declared invalid by two celebrated English statutes which have been substantially re-enacted throughout the United States with the same provisions. The first of these statutes was passed in the 13th year of the reign of Queen Elizabeth (1571), and commonly referred to as the statute 13 Eliz. ch. 5, and by it all fraudulent conveyances, gifts, or alienations of lands or goods whereby creditors might be in anywise disturbed, hindered, delayed, or defrauded of their just rights, are rendered utterly void; but the statute does not extend to any estate or interest in lands on good consideration, and *bona fide* conveyed to any person not having notice of such fraud. The second statute against fraudulent conveyances is the statute 27 Eliz. ch. 4, which was passed in 1585. It provides that the conveyance of any interest in lands for the intent and purpose to

defraud and deceive subsequent *bona fide* purchasers of the lands for a good and sufficient consideration shall be utterly void. This statute differs from the one first mentioned in applying solely to lands, and in protecting the interests of purchasers instead of creditors; but it contains similar provisions declaring the validity of any previous conveyance if it be upon valuable consideration and to a *bona fide* purchaser. It has been held in England, in the interpretation of this statute, that if the previous conveyance be voluntary it is void as to a subsequent purchaser, even if he had notice before he received his deed that such a conveyance had been made. This doctrine has been generally rejected by the courts throughout the United States as unjust, and the principle adopted that the receipt of notice gives a person intending to purchase sufficient opportunity to protect his own interests, and if he is guilty of imprudence in accepting the conveyance he should receive no assistance from the courts. This appears to be the more unobjectionable doctrine. Voluntary conveyances are never set aside under either statute, as between the immediate parties, but only in favor of purchasers or creditors. See FRAUD.

Fraunhofer, Joseph von, yō'sĕf fòn frown'-hō-fĕr, German mathematician: b. Straubing, Bavaria, 6 March 1787; d. Munich 7 June 1826. In 1799 he was placed with a looking-glass maker and glass-grinder at Munich. After various vicissitudes he received an appointment as optician in the mathematical and mechanical institute of Reichenbach at Benedictbeurn, and in 1809 the mechanical part of the optical institute was chiefly under his direction. Ultimately he became one of the members of the firm under which the business was conducted. One of the most difficult operations of practical optics was to polish the spherical surfaces of large object-glasses accurately. Fraunhofer invented a machine which obviated this difficulty, and rendered the surface more accurate than it was left by the grinding. He invented also other grinding and polishing machines, and introduced many improvements into the manufacture of the different kinds of glass used for optical instruments, and which he found to be always injured by flaws and irregularities of various sorts. In 1811 he constructed a new kind of furnace, and on the second occasion when he melted a large quantity found that he could produce flint-glass, which, taken from the bottom of a vessel containing two hundredweight of glass, had the same refractive power as glass taken from the surface. He found that the English crown-glass and the German table-glass both contained defects occasioning irregular refraction. In the thicker and larger glasses there would be more of such defects, so that in larger telescopes this kind of glass would not be fit for object-glasses. Fraunhofer therefore made his own crown-glass. The cause which had hitherto prevented the accurate determination of the power of a given medium to refract the rays of light and separate the different colors which they contain was chiefly the circumstance that the colors of the spectrum have no precise limits, and that the transition from one to another is gradual and not immediate; hence, the angle of refraction cannot in the case of large spectra be measured within 10′ or 15′. To obviate this, Fraunhofer made a series of experiments for the purpose of producing homogeneous light artificially, and unable to effect his object in a direct way, he did so by means of lamps and prisms. In the course of these experiments he discovered that bright fixed line which appears in the orange color of the spectrum when it is produced by the light of fire. This line enabled him afterward to determine the absolute power of refraction in different substances. Experiments to ascertain whether the solar spectrum contains the same bright line in the orange as that produced by the light of fire led him to the discovery of the innumerable dark fixed lines in the solar spectrum, consisting of perfectly homogeneous colors. The importance of this discovery can scarcely be overestimated. It led to the invention and use of the spectroscope, to the science of spectroscopy, and to all our present knowledge of solar and stellar chemistry. Fraunhofer also made a variety of other important discoveries and inventions.

Fraunhofer Lines. See SPECTROSCOPE.

Fraxinus, frăk'sĭ-nŭs. See ASH.

Frazee, Lawrence Fisher, American inventor: b. New Brunswick, N. J., 22 May 1813; d. Jersey City, N. J., 10 Oct. 1896. He became connected with the New Brunswick Steamboat and Transportation Company about 1835; and continued with its successors, the Camden and Amboy, and the Pennsylvania railroad companies till his death. During the Civil War he had command of the transport Massachusetts. He was the inventor of numerous useful appliances.

Frazer, John Fries, American scientist: b. Philadelphia, 8 July 1812; d. there 12 Oct. 1872. Grandson Gen. Persifor Frazer of Revolution. Was graduated with highest honors at the University of Pennsylvania in 1829, and afterward completed courses in both law and medicine. With Professor A. D. Bache he made the first researches on magnetics in the United States. In 1836 he became one of the two assistants on the First Geological Survey of Pennsylvania. After filling for some time a professorship in the Philadelphia High School, in 1844 he succeeded Professor Bache, as professor of natural philosophy and chemistry in the University of Pennsylvania, serving until his death; and from 1855–68 also as vice provost. In 1857 he received the degree of LL.D. from Harvard. He was an active member of the American Philosophical Society (its vice-president in 1855), the Academy of Natural Sciences, and the Franklin Institute (the editor of its journal from 1850 to 1866), and one of the charter members of the National Academy of Sciences.

Frazer, Persifor, American geologist, son of preceding: b. Philadelphia, 24 July 1844. After graduation (1862) from the University of Pennsylvania, served during Civil War in the South Atlantic squadron (1862–63) as aide, United States coast survey; in the cavalry during Gettysburg campaign, and as ensign in the navy to the end. Was mineralogist and metallurgist to the United States geological survey (1869–70), professor of chemistry in the University of Pennsylvania (1870–74), assistant geologist second geological survey of Pennsylvania, 1874–82. He was the first foreigner to receive the degree of Docteur ès-Sciences Naturelles from France, which also gave him the decoration of the golden palms of the Academy. He served as vice-president, representing the

United States in the International Geological Congress of 1888 (London), and of 1897 (St. Petersburg). He has written extensively for scientific periodicals, published five volumes of Reports of the Geological Survey of Pennsylvania; ‘Tables for the Determination of Minerals’ (1874); and ‘Bibliotics, or the Study of Documents’ (1894).

Fraziers Farm, Battle of. See GLENDALE, BATTLE OF.

Frear, Walter Francis, American jurist: b. Grass Valley, Cal., 29 Oct. 1863. He was graduated at Yale University in 1885, and at the Yale Law School in 1890; was made second judge of the first circuit court of Hawaii, in January 1893, first associate justice in the supreme court of the Republic of Hawaii in January 1896. He was a member of the commission to recommend to Congress legislation for Hawaii, in August, 1898, and became chief-justice of the Supreme Court of Hawaii in July 1900. He is the author of ‘Evolution of the Hawaiian Judiciary’; etc.

Frechette, Louis Honoré, loo-ē ō-nō-rā frā-shĕt, French Canadian poet: b. Levis, Quebec, 16 Nov. 1839. He has edited several French Canadian journals and in 1889 became clerk of the Legislative Council of Quebec. His lyrics have been much admired both for their form, and sincerity of passion. His published books include: ‘Mes Loisirs’ (1863); ‘La Voix d'un Exilé’ (1869); ‘Pèle Mele’ (1877); ‘Les Fleurs Boreales,’ crowned by the French Academy (1880); ‘Les Oiseaux de Niège’ (1880); ‘La Legende d'un Peuple’ (1887); ‘Les Feuilles Volonte’ (1891); ‘Veronica,’ a drama; and in prose ‘Lettres à Bastile’ (1872); ‘Histoire Critique des Rois de France’ (1881); ‘Originaux et Detraques’ (1893); ‘Lettres sur l'Education’ (1893); ‘La Noël au Canada’ (1900).

Freckles, brownish-yellow spots of a circular form on the human skin. They are due to excess of pigmentary matter in the cells of the cuticle, immediately above the true skin, and only appear on those exposed surfaces, as the neck, face, hands, and arms. They are sometimes congregated in thick clusters which give to the features an unsightly appearance. Sometimes freckles are hereditary, appearing soon after birth, and continuing through life, or subsiding or vanishing altogether. This affection is most common as well as most persistent in persons of fair complexion and hair, and especially so in those with red hair. There can be no doubt that exposure to the sun increases the disfigurement.

Frederic, Harold, American journalist and novelist: b. Utica, N. Y., 19 Aug. 1856; d. London, England, 19 Oct. 1898. He was for many years London correspondent of the New York *Times*. His writings include: ‘Seth's Brother's Wife’ (1887); ‘The Lawton Girl’ (1890); ‘In the Valley’ (1890); ‘The Return of the O'Mahoney’ (1892); ‘The New Exodus’ (1892); ‘The Copperhead,’ a tale of the Civil War (1895); ‘Marsena’ (1895); ‘The Damnation of Theron Ware’ (1896); ‘March Hares,’ a study of contemporary social life (1896); ‘Gloria Mundi’ (1898); ‘In the Market Place’ (1899).

Fredericia, frĕd-ĕ-rĭsh'ē-ä, Denmark, seaport, on the coast of Jutland. It was at one time well fortified, but the forts have not been kept in repair. The chief exports are eggs, meat, fish, cheese, and butter; the chief imports are cotton and woolen goods, fruit, salt, and petroleum. Pop. (1900) 12,700.

Frederick I., king of Denmark and Norway: b. 3 Sept. 1471; d. 10 April 1533. He succeeded his nephew Christiern (or Christian) II., on the deposition of the latter, in 1523, and entered into an alliance with Gustavus I., king of Sweden. After taking Copenhagen, he gained over all the nobility, and introduced Lutheranism into his dominions.

Frederick II., king of Denmark, the son and successor of Christian III.: b. 1534; d. 1588. He ascended the throne in 1559. He was a great friend of learning, and was a patron of Tycho Brahe and other men of science. He waged a long war with Sweden, which ended in 1570.

Frederick III., king of Denmark: b. Hadersleben, Schleswig, 18 March 1609; d. Copenhagen 9 Feb. 1670. He succeeded his father Christian IV., in 1648. The most remarkable event of his reign was his changing of the constitution from an elective to an hereditary monarchy.

Frederick IV., king of Denmark: b. Copenhagen 11 Oct. 1671; d. there 12 Oct. 1730. He ascended the throne on the death of Christian V. in 1699. He leagued against Charles XII. of Sweden, who forced him to make peace; but when Charles fled to Turkey, Frederick drove the Swedes out of Norway, and concluded a favorable peace; retaining possession of the duchy of Schleswig.

Frederick V., king of Denmark: b. Copenhagen 31 March 1723; d. 14 Jan. 1766. He came to the throne in 1746. The character of his reign may be inferred from the following remark, which, on his deathbed, he made to his successor, Christian VII.: "It is a great consolation to me, my son, that I have not injured any person, and that my hands are not stained with one drop of blood."

Frederick VI., king of Denmark: b. Copenhagen 28 Jan. 1768; d. there 3 Dec. 1839. He ascended the throne in 1808, though, from 1784, he was associated in the government with his father, who had lost his reason. On his accession he had to repair the damages done by the English in their bombardment of Copenhagen in 1807, and to wage a war with the Swedes, who attempted to possess themselves of Norway. He succeeded in defeating them, and peace was signed at Jon Kœping, in 1899. Allying himself with Napoleon, Norway was, in 1814, given to Sweden, under Bernadotte; Pomerania and the isle of Rügen falling to Denmark. More tranquil times now arriving, Frederick devoted himself to the extension of the internal resources of his kingdom.

Frederick VII., king of Denmark: b. Copenhagen 6 Oct. 1808; d. Glücksburg 15 Nov. 1863. He ascended the throne in 1848. He was well known as an archæologist, publishing numerous works on the subject. On his death, the elder line of the house of Oldenburg became extinct.

Frederick I., surnamed **Barbarossa,** emperor of the Holy Roman Empire, son of Fred-

erick, Duke of Suabia: b. 1121; d. June 1190. He was chosen to succeed his uncle Conrad III. in 1152. He was crowned at Aix-la-Chapelle a few days after his election. His great ambition was to secure the independence of the empire, and, above all, to be master of Italy. His first expedition to Italy was made in 1154, when, after subduing several towns in Lombardy, he went to Rome, and, after some delays, had himself crowned emperor by Adrian IV. He marched again into Italy in 1158, took Brescia and Milan, and at the celebrated Diet at Roncaglia assumed the sovereignty of the towns and received the homage of the lords. On his return to Germany he triumphed over Bohemia, and made Poland tributary to the empire. After the death of Pope Adrian, Frederick had three anti-popes in succession elected in opposition to Alexander III., who excommunicated him and his pope, Victor. The same year, 1160, he besieged and took Crema, after a most courageous defense. In 1162 he conquered Milan, and had many of the public buildings destroyed, as well as parts of the fortifications; after which the other towns of Lombardy submitted to him. In 1166, he traversed the Romagna, levied contributions on the towns, besieged Ancona, and had himself crowned a second time at Rome by the anti-pope, Pascal. A fresh league being formed against him, he put its members under the ban of the empire and returned to Germany. In 1174 he besieged unsuccessfully the newly founded town of Alessandria, and in the following year was totally defeated by the Milanese at Como. Soon after he made peace with the Pope and the towns of Lombardy. In 1188 he assumed the cross, set out in the following year on the third crusade, was opposed on the march by the Greek emperor and the sultan, arrived in Asia, and was drowned while crossing a river. Frederick was great, not only as a soldier, but as a ruler. His administration was marked by justice, his subordinate officers were chosen for their capacity and probity, he was himself an educated man and promoted education and literature. His memory is still cherished among the peasants of Germany, who dream of the return of Fritz Redbeard, as the Welsh did of King Arthur. Consult: Prutz, 'Kaiser Friedrich I.' (1871–3); Fischer, 'Kreuzzug Friedrichs I.' (1870).

Frederick I., first king of Prussia (FREDERICK III. as elector of Brandenburg): b. Königsberg 22 July 1657; d. Berlin 25 Feb. 1713. He succeeded his father in 1688, entered into the alliance against France, and seized Bonn and other towns, sent auxiliaries to the emperor against the Turks, and, after a dispute of some years, sold to the emperor the circle Schwiebus, which the Great Elector had acquired in exchange for the principalities of Liegnitz, Brieg, and Wohlau. He supported the emperor in the war of the Spanish Succession, and in 1701 obtained from him the title of king, which he had long coveted. Frederick gratified his love of pomp in the ceremony of his coronation at Königsberg, the cost of which exhausted his treasury for a time. He placed the crown on his head with his own hands. In 1694 he founded the University of Halle; two years later the Berlin Academy of Painting; and, in 1707, he established the Academy of Sciences, Berlin, and made Leibnitz first president.

Frederick I., William Charles, duke (1797–1803), elector (1803–6), and king (1806–16) of Würtemberg: b. Treptow, Pomerania, 6 Nov. 1754; d. 30 Oct. 1816. He was a son of Sophia Dorothea, niece of Frederick the Great. In 1797 he became duke. His title of king, with a large accession of territory, he gained through an alliance with Napoleon. In 1806 he joined the Confederation of the Rhine; in 1809, 1812, and 1813 fought for Napoleon, but in 1813 took side with the allies.

Frederick I., William Louis, grand-duke of Baden: b. Karlsruhe 9 Sept. 1826. He was the second son of the Grand-duke Leopold. In 1856 he assumed the grand-ducal power. He restored the constitution in its full effect; and devoted himself to the promotion of art and science and the spiritual and material interests of his realm. Though he took side with Austria in 1866, he later worked for the admission of Baden to the North German Confederation.

Frederick II., emperor of the Holy Roman Empire: b. Jesi 26 Dec. 1194; d. Viorenzuoli 13 Dec. 1250. He was elected king of the Romans in 1196, again after the death of his father, Henry VI., and a third time on the excommunication of Otho IV., in 1211. He was already king of Sicily and duke of Suabia, under the joint regency of his mother and Pope Innocent II. He made a league with Philip Augustus, king of France, and after the defeat of Otho by the latter at the battle of Bouvines, was crowned at Aix-la-Chapelle in 1215. He received the imperial crown at Rome in 1220, on which occasion he had to renew a vow previously extorted from him to take the cross. In 1225 he married Yolande, daughter of John of Brienne, king of Jerusalem, and in 1227 embarked for the Holy Land. Illness compelled him in a few days to land again, and for this he was excommunicated by Pope Gregory IX. He set out again in 1228, and the Pope exciting opposition to him, and invading his hereditary states, he at once concluded a truce with Kameel, the sultan of Egypt, by which he became master of Jerusalem. He entered the city, crowned himself (no priest daring to do it), and returned to Europe. He recovered his states, made peace with the Pope, and suppressed the revolt of his son Henry, who was then imprisoned for life. In 1235 Frederick began the war with the cities of Lombardy, having for his ally Eccelino, tyrant of Verona. After his victory of Cortenuova, he took Ravenna, Faenza, and Benevento; and, in 1241, his fleet defeated that of the Genoese, and captured the cardinals and bishops who were on their way to attend a council against him. Frederick promoted the election of Innocent IV., who had been his friend, and made a treaty with him; but soon found Innocent a most determined enemy. A new anathema and sentence of deposition, and release of his subjects from their allegiance to him, was published in 1245. The mediation of St. Louis utterly failed to bend the Pope to reconciliation. Rival emperors were set up, the war in Italy continued, Parma was lost in 1248, his son Enzio was defeated and made prisoner in the following year. Frederick was the most accomplished sovereign of the Middle Ages; but his strong sympathies with his Italian motherland, and his unremitting endeavors to establish a compact and all supreme empire in Italy,

were the causes not only of his own misfortunes but of the miseries which he brought on the German empire by embroiling him in costly wars abroad, and leading him to neglect the welfare and sacrifice the interests of his German subjects.

Frederick II., landgrave of Hesse-Homburg, called "Prince of Homburg": b. 9 June 1633; d. 24 Jan. 1708. He fought bravely at Copenhagen (January 1659), where his leg was shot away and its silver substitute gained him the sobriquet "mit dem silbernen Bein." In 1670–8 he was a general of cavalry in the army of Frederick William, the great elector of Brandenburg, to whose victory over the Swedes at Fehrbellin (1675) he contributed the chief part. Having succeeded to power in 1681, he renovated the saline springs of Homburg, beautified the city, and made it prominent as a watering-place.

Frederick II., best known as **Frederick the Great,** king of Prussia: b. 21 Jan. 1712; d. Sans Souci 17 Aug. 1786. He was the son of Frederick William I., and the Princess Sophia Dorothea of Hanover. Though, by the direction of his father, he was instructed only in the details of military exercises and service, his taste for poetry and music was early developed by the influence of his first instructress, Madame de Rocoules, and his early teacher, Duhan, who, countenanced by the queen, formed a secret opposition to his father's system of education. The prince's inclination led him to adopt entirely the views of his mother. This gave rise to a coolness between him and his father. Indignant at the oppression and hatred which he experienced from his father, Frederick determined to flee to the court of George II., king of England, his mother's brother. His sister Frederica and his friends, Lieuts. Katt and Keith, were the only persons entrusted with the secret of his flight. He was, however, overtaken, was barbarously treated by his father, and obliged to be an eye-witness of the execution of his friend Katt.

While the prince remained in the closest confinement in Küstrin, the king sent a proposal to him to renounce the succession in favor of his younger brother Augustus William, on condition that he should have the liberty of pursuing his own inclinations in regard to his studies, traveling, etc. "I accept the proposal," said the prince, "if my father declares that I am not really his son." On this answer the king, who looked on conjugal fidelity with religious respect, relinquished his plan. That the king was inclined to sentence his son to death is certain. But the provosts Reinbeck and Seckendorf, who had before intrigued against the prince, now saved his life; the latter, in particular, by availing himself of the interference of the emperor.

The prince was not admitted to court till on the occasion of the nuptials of his sister Frederica, and was obliged by his father in 1733 to marry the Princess Elizabeth Christina, daughter of Ferdinand Albert, duke of Brunswick-Bevern. Frederick William gave the castle of Schönhausen to her, and to the prince the county of Ruppin, and in 1734 the town of Rheinsberg, where he lived devoted to study till he ascended the throne. Among his daily visitors were literati, musicians, and painters. He corresponded with foreign scholars, particularly with Voltaire, whom he greatly admired. Several of his writings, in particular his 'Antimacchiavel,' had their origin in the rural tranquillity of Rheinsberg.

The death of his father raised him to the throne 31 May 1740. Frederick on his accession found in his states a population of only 2,240,000. At his decease he left 6,000,000. He raised Prussia to this pitch of greatness by his talents as a legislator and general, assisted in the field and in the cabinet during a reign of 46 years by many distinguished men. Frederick II., who had already excited great expectations, retained for the most part the institutions and laws of his father, but gave to the latter more extent and vigor. The death of the Emperor Charles VI. was a favorable moment, of which Frederick II. took advantage, to revive the claims of the house of Brandenburg with regard to the Silesian principalities, so far as to ask from the queen, Maria Theresa, the duchies of Glogau and Sagan, in return for which he promised her assistance against all her enemies, his vote for the election of her husband as emperor, and 2,000,000 Prussian dollars. These proposals being rejected, he occupied Lower Silesia in December 1740, and defeated the Austrians 10 April 1741, near Molwitz. This victory which was almost decisive of the fate of Silesia, raised new enemies against Austria. France and Bavaria united with Prussia, and the war of the Austrian Succession commenced. The only ally of the queen of Hungary and Bohemia, George II. of England, advised her to make peace with Prussia, because Frederick II. was her most active and formidable enemy. After the victory of Czaslau (Chotusitz), gained by Frederick 17 May 1742, the first Silesian war was terminated by the preliminaries signed at Breslau under British mediation (11 June), and by the peace signed at Berlin 28 July 1742. Frederick obtained Lower and Upper Silesia, and the larger part of the county of Glatz, with full sovereignty. On the other hand he renounced all claims to the other Austrian territories, assumed a debt of 1,700,000 Prussian dollars charged on Silesia, and promised to respect the rights of the Catholics in Silesia. Saxony acceded to this peace, of which England and Russia were the guarantees.

Frederick II. seized the opportunity of a peace to introduce useful institutions into the conquered territories, and to render his army more formidable. In 1743 on the death of the last Count of East Friesland, he took possession of that country, the reversion of which had been granted to his family in 1644 by the emperor. The war of the Austrian Succession continued; the Emperor Charles VII. was driven from his hereditary estates of Bavaria, and the Austrians were everywhere victorious. Frederick, apprehensive that an attempt would be made to recover Silesia, entered into a secret alliance with France (April 1744), and with the emperor, the palatinate, and Hesse-Cassel, in Frankfort (22 May 1744). He promised to support the cause of the emperor by the invasion of Bohemia, on condition that he should receive the circle of Königgrätz. He entered Bohemia suddenly, 10 Aug. 1744, and captured Prague; but the Austrians and Saxons compelled him to evacuate Bohemia before the close of the year. The death of the emperor (18 Jan. 1745), and the defeat of the Bavarians at Pfaffenhofen, obliged Maximilian Joseph, the young elector

of Bavaria, to conclude the Peace of Fuessen with Maria Theresa, and occasioned the dissolution of the Alliance of Frankfort, after Hesse-Cassel had already declared itself neutral. The victory of the Prussians over the Saxons at Kesselsdorf, 15 Dec. 1745, led to the Peace of Dresden (25 December). Frederick retained Silesia, acknowledged the husband of Maria Theresa, Francis I., as emperor, and Saxony promised to pay 1,000,000 Saxon dollars to Prussia.

During the 11 following years of peace Frederick devoted himself with the greatest activity to the domestic administration, to the improvement of the army, and at the same time to the Muses. It was at this time that he wrote his 'Mémoires pour servir à l'Histoire de Brandenbourg,' his poem, 'L'Art de la Guerre,' and other works in prose and verse. He encouraged agriculture, the arts, manufactures, and commerce, reformed the laws, increased the revenues of the state, perfected the organization of his army which was increased to 160,000 men, and thus improved the condition of the state.

Secret information of an alliance between Austria, Russia, and Saxony gave him reason to fear an attack and the loss of Silesia. He hastened to anticipate his enemies by the invasion of Saxony, with which the Seven Years' War, or third Silesian war, commenced. The Peace of Hubertsburg (15 Feb. 1763), terminated this war, without any foreign interference, on the principle that the contracting parties should remain in *statu quo*. Frederick came out of the Seven Years' War with a reputation which promised him in the future a decisive influence in the affairs of Germany and Europe. His next care was the relief of his kingdom, drained and exhausted by the contest. He opened his magazines to furnish his subjects corn for food and for sowing. To the peasants he distributed horses for plowing, rebuilt at his own expense the houses destroyed by fire, established new settlements, built manufactories, and laid out canals. In 1764 Frederick founded the Bank of Berlin, with a capital of 8,000,000 Prussian dollars.

A treaty was concluded with Russia (31 March 1764), in consequence of which Frederick supported the election of the new king of Poland, Stanislaus Poniatowski, and the cause of the oppressed Dissidents in Poland. For the purpose of connecting Prussia with Pomerania and the Mark, and of enlarging and consolidating his territories, Frederick consented to the first partition of Poland proposed at St. Petersburg and concluded 5 Aug. 1772. Frederick received the whole of Polish Prussia (which had been ceded to Poland by the Teutonic Order in 1466) with the part of Great Poland to the river Netz, excepting Dantzic and Thorn. From this time the kingdom of Prussia was divided into East and West Prussia. He declared against the possession of a large part of Bavaria by Austria in 1778, after the death of Maximilian Joseph, elector of Bavaria, without issue, but Austria was not to be diverted from her designs by negotiations. Saxony, therefore, formed an alliance with Prussia and Frederick invaded Bohemia with two armies (July 1778). The Emperor Joseph, in a strongly fortified camp behind the Elbe, could not be induced to give battle. The aged Empress Maria Theresa wished for peace. But Catharine II. having declared her intention of assisting Prussia with 60,000 men, this war of the Bavarian Succession was terminated without a battle by the Peace of Teschen (13 May 1779). Austria consented to the union of the principalities of Franconia with Prussia, and renounced the feudal claims of Bohemia to those countries. In the evening of his active life Frederick concluded, in connection with Saxony and Hanover, the confederation of the German princes, 23 July 1785.

Frederick left to his nephew, Frederick William II., a kingdom increased by 29,000 square miles, more than 70,000,000 Prussian dollars in the treasury, an army of 200,000 men, great credit with all the European powers, and a state distinguished for population, industry, wealth, and science. Improved by severe experience before he ascended the throne, and possessed of rare talents, Frederick shook the political system of Europe when he conceived and established, in accordance with the wants of his time, the confederation of princes, the master-work of his policy. One of his great merits is that in the most difficult circumstances he contracted no public debts, but on the contrary, though he distributed a considerable part of his revenues in different ways among his subjects, he had a richer treasury than any monarch in Europe ever possessed. His contempt for ecclesiastical establishments, which was considered by his contemporaries as a contempt of religion, has been censured, and his writings show that his heart was a stranger to the highest sentiments of piety. Entirely unacquainted with the literature and mental cultivation of Germany, he underrated it, and contributed nothing to its improvement.

Some of Frederick's writings were published during his lifetime, but most of them appeared first in the 'Œuvres Posthumes' (1788–9). In 1846–57 the Berlin Academy published a critical edition of the whole, together with his literary and private correspondence, under the title 'Œuvres de Frédéric le Grand' (31 vols.).

Consult Loryman, 'Frederick the Great and the Seven Years' War' (1881); Carlyle, 'History of Frederick II.' (1858–65); Tuttle, 'History of Prussia under Frederick the Great' (1888); Lavisse, 'La jeunesse du grand Frédéric' (1891); Lavisse, 'Le grand Frédéric avant l'événement' (1893); Koser, 'Friederich der Grosse als Kronprinz' (1901).

Frederick II., landgrave of Hesse-Cassel: b. 14 Aug. 1720; d. Castle Weissenstein, Wilhelmshöhe, 31 Oct. 1785. He ascended the throne in 1760. By the aid of his architect, Du Ruy, he greatly beautified his capital, in which he founded the Collegium Carolinum, the museum, the library, and an academy of painting and sculpture. He sold a corps of 12,000 troops to England for service in America during the Revolution; whence, in the patriot mind, a stigma attached to the name "Hessian."

Frederick III., emperor of the Holy Roman Empire: b. Innsbruck 21 Dec. 1415; d. Linz 19 Aug. 1493. He was elected emperor in 1440 and ruled for 53 years, the longest German reign. His sobriquet was "the Pacific," owing to his plans for the pacification of the empire.

He left it to his son Maximilian to carry out the device inscribed upon his palaces and books, A, E, I, O, U; which characters are

FREDERICK THE GREAT,

ONE OF THE STATUES PRESENTED TO HARVARD UNIVERSITY BY EMPEROR WILLIAM II.

generally supposed to represent the motto, *Austriæ est Imperare Orbi Universo* («Austria is to rule the world»).

Frederick III. (the Wise), elector of Saxony: b. Torgau 17 Jan. 1463; d. 5 May 1525. He succeeded his father, Ernest, and is known chiefly as founder of the University of Wittenberg, and as the friend and very cautious protector of Luther, one of the first professors of the new university. It was by his arrangement that Luther, after the Diet of Worms, was seized and carried off to Wartburg. He did not, however, establish the reformed faith in his dominions. He became administrator of the empire in 1519, and was offered the imperial crown, but declined it.

Frederick III., king of Prussia, second emperor of modern Germany: b. Potsdam 8 Oct. 1831; d. 15 June 1888. He married in 1858 the Princess Royal of England, the eldest daughter of Queen Victoria. He early entered the army of Prussia, and when the latter declared war against Austria in 1866 the crown prince, as he was called, became commander of the army of the Oder. By a series of rapid marches from Silesia through the Sudetic mountain passes into Bohemia his army arrived just in time to aid Prince Frederick Charles and snatch the decisive victory of Sadowa. At the outbreak of the Franco-German war he commanded the third German army, which numbered 200,000 men, and with these he advanced to attack the French under MacMahon. The first assault was made at Weissenburg (4 August), and two days later he successfully turned the French defense at Woerth, causing the disorderly retreat of MacMahon's army. He pressed northward closely after MacMahon, and the passage of the Meuse by the Germans under his command greatly contributed to the successful turning of the French advance, and the final surrender at Sedan. This accomplished, he pushed on to Paris, and after surrounding the city established his headquarters at Versailles, where he remained until the capitulation in January 1871. In 1887 he was attacked by a throat disease, and while undergoing treatment for this his father died, and he became emperor in March 1888. The announcement of his own death three months later was received with wide regret, for his renown as a military commander, his liberal views, his large-heartedness, and his resignation under suffering, had touched his personality with the rarest heroic qualities.

Frederick III., elector of Brandenburg. See FREDERICK I. OF PRUSSIA.

Frederick V., elector-palatine and king of Bohemia: b. Amberg 1596; d. Mentz, Germany, 19 Nov. 1632. He succeeded his father, Frederick IV., in 1610. In 1618 he married the Princess Elizabeth, daughter of James I. of England, and in the following year accepted the crown of Bohemia. He made a triumphal entry into Prague, followed in 1620 by his total defeat by the Imperial forces at the battle of Prague, and the loss of his kingdom and hereditary states. He then took refuge in Holland.

Frederick Augustus II., elector of Saxony and king of Poland. See AUGUSTUS II.

Frederick Augustus III., elector of Saxony and king of Poland. See AUGUSTUS III.

Frederick Charles, Prince of Prussia: b. Berlin 20 March 1828; d. Castle of Klein-Ghericke, near Potsdam, 15 June 1885. He was a son of Frederick Charles Alexander and nephew of William I. He was in command of the first Prussian army which made so vigorous a resistance, and, aided by the second army, which arrived opportunely, finally defeated the Austrians at the battle of Sadowa (Königgrätz). In the Franco-German war he commanded the second army, directed the siege-operations against Metz, and 28 Nov. 1870 defeated the army of the Loire.

Frederick, Christian August, duke of Schleswig - Holstein - Sonderburg - Augustenburg: b. Castle Augustenburg, island of Alsen, 6 July 1829; d. Wiesbaden 14 Jan. 1880. He was banished by Denmark in 1851, after having taken part in the insurrection as an officer of the general staff. Upon the conclusion, however, of the war between Denmark and Germany, he was proclaimed duke by a popular assembly at Elmshorn in 1864, and received allegiance at Kiel. But he was not destined to rule. The duchy, by the terms of the Treaty of Vienna, fell to Austria and Prussia for disposal, and Prussia, through Bismarck, imposed upon Frederick conditions which he rejected. After the war with Austria, his domains were incorporated with Prussia. He took part in the Franco-German war as a Bavarian general on the general staff of the Prussian crown prince. His daughter, Augusta Victoria, was married to Prince William of Prussia, later William II., emperor of Germany.

Frederick Louis, Prince of Wales: b. Hanover, Germany, 6 Jan. 1707; d. Leicester House, London, 20 March 1751. He was the eldest son of George II. He became the leader of the Opposition, which was strongly against Walpole and styled itself the Patriot party. In the contest between Handel and Buononcini he was a partisan of the latter. At the outbreak of the rebellion of 1745 he sought, but did not obtain, the command of the royal army. His eldest son became King George III.

Frederick William I., king of Prussia: b. Berlin 15 Aug. 1688; d. Potsdam 31 May 1740. He commenced his reign in 1713, after having married the daughter of the elector of Hanover, afterward George I. of England. In 1715 he declared war against Charles XII. of Sweden, and in conjunction with Denmark took Stralsund; but on the death of Charles, in 1718, he made peace. The habits of this sovereign were entirely military, and he labored unweariedly to promote the discipline of his troops. One of his strongest peculiarities was an extraordinary love for tall soldiers; and in order to procure them had agents employed in all parts of Europe. He held science and literature in profound contempt; but money he worshipped, and men of a military character after his own ideal he respected and encouraged. The consequence was that he left an abundant treasury and a well-appointed army of 66,000 men. He was succeeded by his son Frederick the Great.

Frederick William I., last elector of Hesse: b. Philippsruhe 20 Aug. 1802; d. Prague 6 Jan. 1875. He succeeded to the throne in 1847. His reign was disturbed by conflicts with his people due to his efforts to disregard the constitution of 1831 and to limit popular representa-

tion. In 1866 he took sides with Austria in the war with Prussia, was deposed, and for a time imprisoned. In the same year Hesse was annexed to Prussia, in which the larger portion of it is now incorporated with the province of Hesse-Nassau.

Frederick William II., king of Prussia: b. 25 Sept. 1744; d. 16 Nov. 1797. He was the eldest son of Prince August William, brother of Frederick the Great, and ruled from 1786 to 1797. As the result of an interview at Pilnitz in 1791, he arranged with the emperor of Austria to interfere in aid of Louis XVI. of France. The ensuing campaign was an inglorious one, concluded by a retreat to the Rhine in the autumn of 1792. The war was ended in 1795, and Frederick William ceded to France Prussian territory west of the Rhine. From the second (1793) and third (1795) partitions of Poland he acquired large territory.

Frederick William III., king of Prussia: b. 3 Aug. 1770; d. 7 June 1840. He commenced his reign in 1797 by maintaining a strict neutrality in the various alliances with and against France, which resulted from the ambitious designs of Napoleon I. In 1805, however, he yielded to the solicitations of Russia, allying himself with the czar against the French emperor. The rapid campaign of 1806, and the defeat of the Prussians at Jena, opened the gates of Berlin to the enemy, in whose hands it remained till 1809. In 1807 the battle of Friedland led to the humiliating peace of Tilsit. Restored to his capital, the king diligently endeavored to repair the evils of war; but new disasters overtook him, and his kingdom suffered greatly during the struggle from 1812 to 1814. He subsequently joined his troops with those of Russia. The allies having triumphed over the French at Leipsic, Frederick William in 1814, entered Paris with Czar Alexander. On the return of Napoleon from Elba, he once more joined the allies. After the victory of Waterloo, in which the Prussians, under Blücher (q.v.) played an important part, Prussia, once more at peace, gradually recovered the losses she had sustained, under the wise and paternal sway of Frederick, whose constant efforts and moderation contributed greatly to the maintenance of peace. Throughout his life, he was a warm defender of the Protestant religion, and a patron of education. He never redeemed his promise, however, to bestow a representative constitution on his people. The establishment of the provincial estates only affected very slightly the absolute power, which, it is true, he wielded with ability, and with a kind of paternal affection for his people. It may finally be said of him, that, a waverer between the Absolutist party and the Liberal party, he secured, as is the lot of most undecided men, the respect and adherence of neither.

Frederick William IV., king of Prussia: b. 15 Oct. 1795; d. near Potsdam 2 Jan. 1861. On the death of his father Frederick William III. succeeded to the throne in 1840. He evinced, at an early period of his life, a very great love for the arts, which he preserved throughout his career. During the first years of his reign his subjects anxiously demanded the reform of the government, requiring the liberal constitution which had been promised them in 1815, in return for the great sacrifices they had made during the continental war. In 1847, at a general diet of the Prussian states, many of these reforms were granted, and it was thought that the kingdom might escape the troubles of the next year's revolution. In March 1848, however, the king was obliged to change the ministry, to issue a general amnesty, and commence a war in favor of Schleswig against Denmark. In the war between the western powers and Russia, the king preserved a strict neutrality, though earnestly solicited by each party to espouse its side in the conflict. In 1856, in consequence of an attack on Neufchâtel by some Prussian partisans, war was in danger of breaking out between Switzerland and Prussia; but this was avoided, and a treaty concluded, in May 1857, in reference to the king's claims on that place. In the complication relative to the Danubian principalities, Prussia followed the lead of France and Russia as opposed to England and Austria. Toward the end of 1857, a severe illness, resulting in the loss of some of his faculties, caused his brother William to be nominated regent, who succeeded him as king.

Frederick William, duke of Brunswick: b. Brunswick 9 Oct. 1771; d. at Quatre-Bras 16 June 1815. He entered the Prussian military service in 1788, and in 1800 was commissioned major-general. With a Bohemian volunteer corps he invaded Saxony, and with Austrian reinforcements took Dresden and Leipsic. After the armistice of Znaim, he defeated Reubel's corps, 6,000 strong, at Oelger, near Brunswick, finally arrived at Elsfleth and Brake, seized all available shipping, and embarked for England, where he was received with demonstrations of enthusiasm. He participated in the Peninsular war, and returned only after the battle of Leipsic (1813). He was shot while leading an attack at Quatre-Bras.

Frederick William, elector of Brandenburg, called the Great Elector: b. 16 Feb. 1620; d. Potsdam 29 April 1688. He succeeded his father when the unhappy Thirty Years' war was still raging in Germany, and his conduct toward both parties was prudent. In 1641 he concluded a treaty of neutrality with Sweden, notwithstanding the earnest remonstrances of Austria. In 1644 he concluded an armistice with Hesse-Cassel, by which Cleves and the county of Mark were restored to him, and by the Peace of Westphalia in 1648 received Madgeburg, Halberstadt, and Kammin. In the war between Poland and Sweden (in 1655) he was obliged to take part, on account of the duchy of Prussia. He supported both parties in turn, and obtained an acknowledgment of the independence of the duchy of Prussia from Poland, upon whom it was formerly dependent. In 1672 he concluded a treaty with the Dutch Republic, when this state was threatened by Louis XIV. On June 6, 1673, he concluded a treaty with France at Vossem, by which France promised to evacuate Westphalia, and to pay 800,000 livres to the elector, who, in return, broke off his treaty with Holland, and promised not to render any aid to the enemies of France. In 1674 the German empire declared war against France. In the following December a Swedish army, at the instigation of France, entered Pomerania and the Mark. The elector defeated them, 18 June 1675, at Fehrbellin. In 1678 he concluded a separate peace with France, at Nimwegen, as did also Holland and

Spain. France demanded the restoration of all the conquered territories to Sweden. The elector, having refused compliance, formed an alliance with Denmark, and waged a new war against Sweden, but was obliged to submit, by the Peace of St. Germain, 29 June 1679. Louis XIV. having occupied several circles of Alsace by his famous *chambres de réunion,* Frederick William effected an armistice of 20 years between France and Germany (in 1684). But when he renewed (1685) his treaty with Holland, and received into his dominions about 14,000 Protestant refugees from France, new difficulties arose between him and France, which brought him into a closer connection with Austria. He received the circle of Schwiebus in 1686, and in the same year sent 8,000 men to assist the Austrians against Turkey.

The elector paid great attention to the promotion of agriculture and horticulture, and, by affording protection to the French refugees, gained 20,000 industrious manufacturers. A colossal statue of Frederick William in bronze, at Berlin, was cast by Jacobi, in 1700, and is still one of the greatest ornaments of that city. Consult: Hitl, 'Der grosse Kurfürst und seine Zeit' (1893); Philippson, 'Der grosse Kurfürst' (1897–1902).

Frederick, Md., city, county-seat of Frederick County; on Carroll's Creek, and on the Pennsylvania, and the Baltimore & O. R.R.'s; 62 miles northwest of Baltimore. Here are Frederick College, Woman's College of Frederick, and the State institution for the deaf and dumb. The city has manufactories of coaches, leather, shoes, knit goods, shirt-waists, palmetto, fibre brushes, tobacco, etc., and an assessed property valuation of nearly $4,000,000. During the Civil War it was twice occupied by the Confederates, the second time, in 1864, by Gen. Early, who forced the citizens to pay a ransom of $200,000. In 1862 Federal troops under Gen. McClellan occupied the place. Pop. (1900) 9,296.

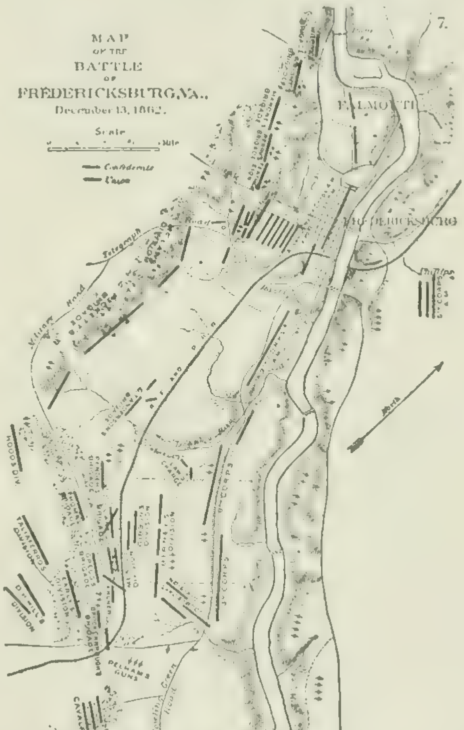
Fredericksburg, Tex., town, county-seat of Gillespie County; on the San Antonio & A. P. R.R.; 80 miles west of Austin. It was founded by a German colony in 1846. Pop. (1900) 1,532.

Fredericksburg, Va., city in Spottsylvania County; on the Rappahannock River, and the Richmond, F. & P., and the Potomac, F. & P. R.R.'s; 61 miles north of Richmond. It has tanneries, iron works, cigars, ice, and shoe factories, and an assessed property valuation of nearly $2,000,000. It was the scene of several battles during the Civil War and 15,300 graves of Confederate dead are in the National cemetery here. Pop. (1900) 5,068.

Fredericksburg, Battle of. At the beginning of December 1862 the Army of the Potomac, under command of Gen. Burnside, held the north bank of the Rappahannock River at Falmouth, Va., while the Confederate army, under Gen. Lee, held the south bank at and below Fredericksburg. The Army of the Potomac "present and equipped for duty" numbered 120,281 men, with 312 guns. Gen. Lee's army, strongly entrenched on a broken range of hills back of Fredericksburg, numbered (10 December) "present for duty" 78,513 men, with 270 guns.

The Army of the Potomac was organized into three grand divisions: The right, under Gen. Sumner, consisted of the Second corps, Gen Couch, the Ninth corps, Gen. Willcox, and Pleasonton's cavalry division; the centre, under Gen. Hooker, of the Third corps, Gen. Stoneman, Fifth corps, Gen. Butterfield, and Gen. Averell's cavalry division; the left, under Gen. Franklin, of the First corps, Gen. Reynolds, Sixth corps, Gen. Smith, and Gen. Bayard's cavalry brigade. Gen. Lee's army was divided into two wings, Gen. Longstreet commanding the left, and Gen. Jackson the right.

Burnside concluded to cross the river at and below Fredericksburg by pontoon-bridges. Under great difficulties, with annoyance from the enemy, the bridges were completed 11 December, troops



From original in the possession of the Southern Historical Society. SERIES I VOL. XXI.

rushed over, and by night of the 12th Sumner and Franklin had crossed and taken position. Franklin, who was to open the battle by an attack upon the Confederate right, reinforced by Birney's and Sickles' divisions of the Third corps, and Burns' of the Ninth, had about 60,000 men. At 7.30 A.M. on the 13th, Burnside gave him orders to seize the heights at Hamilton's crossing. One of Franklin's smallest divisions, Meade's, led the attack, moving out at 9 o'clock; but owing to flank attacks and lack of immediate support, it was 1.15 P.M. before Meade drove the Confederates from the Richmond Railroad and, crossing it, charged up a ridge and into the woods, piercing the centre of A. P. Hill's first line; but when he had crossed the road that ran in rear of the crest he was attacked, front and flank, by Hill's second line and the reserves, and was driven back with a loss of over 40 per

cent in killed, wounded, and captured. Gibbon, who had been thrown forward to support Meade's right, shared the same fate, being forced back, with a loss of 1,267 men. The Confederates then advanced beyond the railroad but were checked. Franklin made no further attempt to carry the ridge, but directed his attention to protecting his left, which he thought was seriously threatened. At 2.30 P.M., when Sumner was heavily engaged in front of Marye's Heights, Franklin received Burnside's order to attack with his whole force, but the order was not carried out. Franklin put but a small part of his command into the fight.

Sumner was held in position until after 11 A.M. in the expectation that Franklin would make such an impression upon Lee's right as would enable him to carry the line near the Telegraph and Plank roads. Feeling the importance of haste, Burnside now directed Sumner to begin his movement. In rear of the town, and between it and the heights that Sumner was to carry, was a broken plain, traversed about midway by a canal or ditch, running from right to left. Two roads cut the plain nearly at right angles with the canal; the Plank road on the right, the Telegraph road on the left, leading to Richmond. The advance was to be made on and between these two roads, over ground completely covered by artillery on the heights. McLaws' division held the heights to be assaulted, Cobb's and Kershaw's brigades being placed in the sunken Telegraph road, that ran at the base of the hill. On the side of the road next to the town was a stone wall, shoulder high, behind which Cobb's and Kershaw's men were well protected. The Second corps led in the attack. French's division moved out of the town by parallel streets, and at noon, under a severe artillery and musketry fire, had driven in the Confederate skirmishers and gained a rise of ground, within about 120 yards of the stone wall, from which and the top of the hill it received a most deadly fire. Hancock's division followed in support. At 1 P.M. Couch ordered French and Hancock to carry Marye's Heights. French sent in his three brigades in succession, but they were bloodily repulsed by the deadly fire from behind the stone wall. Hancock now ordered in Zook's brigade. It sprang forward, was joined by some shattered regiments of French's division, and when within 25 paces of the stone wall was repulsed with great loss. The Irish brigade and Caldwell's followed in succession, but failed to carry the position and, after losing one-half, fell back, and both French and Hancock continued, with parts of their commands, to hold the rise of ground near the stone wall. While Hancock's men were falling by hundreds, Howard was ordered to move his division to the right of the Telegraph road and turn the Confederate left, but as French and Hancock needed help, Howard was recalled and ordered in on the Telegraph road, and two divisions of the Ninth corps went in on Couch's left. All fought gallantly, but made no impression upon the Confederate line. French's loss was 1,160; Hancock's 2,032; Howard's 900; Sturgis' division of the Ninth corps lost 1,000, and Getty's division 290.

It was 2 P.M. when Hooker, riding in advance of the Fifth corps, came on the ground. After an examination of the position and conference with Couch and other general officers, he concluded that it would be a useless waste of life to make a further attempt and sent an aide to Burnside, giving his opinion. Burnside ordered him to attack. Hooker then rode to Burnside, across the river, and sought to impress upon him the hopelessness of the attempt, but Burnside reiterated the order to attack. Every available battery opened fire upon the Confederate position, and near sunset Humphreys led his division of the Fifth corps against Marye's Heights, Sykes' division moving on his right. Twice Humphreys led his men forward; some of them were killed within 20 yards of the stone wall; but he was repulsed with a loss of 1,000 men. Sykes, on his right, lost over 200, while Griffin's division, on the left, supporting the Ninth corps, lost over 800 men. Night came with the Union army everywhere repulsed. Burnside directed preparations for a renewal of the battle on the morning of the 14th, when he proposed to lead the Ninth corps, his old command, in an assault where the 2d and 5th Corps had failed, but he was dissuaded from the attempt. From the night of the 13th until the night of the 15th the two armies confronted each other, engaged in artillery-firing and angry skirmishing. On the night of the 15th the Army of the Potomac recrossed the river, after one of its most bloody and humiliating defeats. Its loss was 1,284 killed, 9,600 wounded, and 1,769 missing, an aggregate of 12,653. The Confederate loss was 595 killed, 4,061 wounded, and 653 missing. The loss of the Confederate troops defending Marye's Heights was less than 1,000; that of the attacking and supporting Union troops was over 7,300. Consult: 'Official Records,' Vol. XXI.; Allan, 'Army of Northern Virginia'; Swinton, 'History of the Army of the Potomac'; Walker, 'History of the Second Army Corps'; Powell, 'History of the Fifth Army Corps'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. III.

E. A. Carman.

Fredericton, Canada, county-seat of York County and capital of New Brunswick, is beautifully situated on the west side of the river St. John, 60 miles north-northwest of St. John. It is on the Canadian P. and Canadian East. Rys., and is the terminus of the Fredericton Ry. It is a port of entry and the seat of a United States consular agent. It has handsome public buildings, and is the seat of New Brunswick University and of the provincial normal school. Fredericton has manufactories of iron castings, machinery, leather, boots and shoes, woolen ware, etc., but its chief trade is in lumber and timber products. The city was founded in 1740, first called Saint Anne, and given its present name by Governor-General Sir Guy Carleton in 1785, two years later becoming the capital of the province. Pop. (1901) 7,117.

Fredonia, N. Y., village, in Chautauqua County; on the Dunkirk, A. V. & P. R.R.; about four miles south of Dunkirk, and about 50 miles southwest of Buffalo. It was settled in 1803 and incorporated as a village in 1829. It was early noted for its good schools, including its free academy. It is a residential village with not a large amount of manufactories. It is situated in an agricultural region, in the Lake Erie grape section, and its chief manufactures are canned and dried fruits, grape baskets, and boxes, and patent medicines. Natural gas was discovered here in the early part of the 19th

century and was in use for lighting the village in 1821. The trade is chiefly in fruits, wine, and patent medicines. It has the D. R. Barker free library and one of the State Normal schools. It was for some years the home of William Barker Cushing (q.v.), a United States naval officer. The village owns and operates the waterworks and electric light plant. Pop. (1900) 4,127.

Fredro, frā'drō, Count **Alexander,** Polish dramatist, called "the Molière of Poland": b. Suchorow, Galicia, 1793; d. Lemberg 15 July 1876. He was the founder of Polish comedy, those who preceded him having worked over French plays. 'Mr. Moneybags' (his first piece, 1821); 'Ladies and Hussars'; 'Man and Wife'; and 'Revenge,' are his titles. The scenes are taken from real life.

Free Banking System, the predecessor of and essentially the same as our present national banking system, and on the same principles as the general railroad and corporation laws. Up to 1838 all banks required special charters, with the attendant evils of collusive "blanket" powers, corruption, and an insecurity which was not only a private evil, but seriously affected the state credit and finance. In that year New York State passed a "free" or open banking law, under which anyone could start a bank by depositing with the State an amount of securities equal to its circulating notes. The other States soon followed the precedent.

Free Church, the term applied by British non-conformists to the Christian denominations throughout the British empire, free from state patronage and control. The Free Church of England, a distinct evangelical Protestant denomination founded on the basis of recognizing only two orders, presbyters and deacons, although the first order also comprises bishops, maintains the ecclesiastical parity of presbyters, whether episcopally or otherwise ordained. The governing body is the convocation consisting of all the clergy and laity in the several churches. The denomination originated in the creation of "free churches" in the west of England, as a protest against the Tractarian (q.v.) movement of 1832. The Shore controversy (1843–9), and the Gorham case (1849–50), promoted its development. It was enrolled in chancery by a deed poll in 1863. The bishops are in the Canterbury line of episcopal succession. See Reformed Episcopal Church.

The Free Church of Scotland was the name assumed by the large body of ministers and their adherents who separated from the Established Church of Scotland at the Disruption (q.v.) of 18 May 1843. They seceded in vindication of what they called the "Headship of Christ," that is, to gain liberty to obey what they deemed the will of their Divine Lord in all church arrangements, without the control of the civil power. No new article of faith was adopted, all the forms and rights of the national Church being retained in their integrity. The Church prospered in the face of formidable financial difficulties which were largely overcome by the institution of a sustenation fund, and by the excellent arrangements made for its distribution and employment. After 1867 there was a movement in favor of the union of the Free and United Presbyterian Churches of Scotland, and on 31 Oct. 1900 the union was formally completed by the constitution at Edinburgh of the first assembly of the United Free Church of Scotland. See Presbyterian Church.

The Free Church Association founded in 1866, in English ecclesiology, is a society which has for its main object the abolishment in the Established Church of pew rents and pew ownership, maintaining the equal right of all parishioners to the free use of seats in churches. It has a long list of distinguished patrons, and aids churches with pecuniary grants if "free" and in need. See Institutional Church.

Free Cities, the name applied to various cities of Germany which in the 12th century assisted the emperors in repressing the arrogance of the nobles, and, in return for their services or contributions, received various privileges and immunities and became imperial cities. Free cities existed in Germany from the time of the Romans; they had little in common with the free cities of later times, and in the beginning of the 16th century lost their most essential privileges, and even the name of free cities, through the ignorance and carelessness of their magistrates. The most important of those privileges, as shown in the case of Ratisbon, were, that they should enjoy an independent government; should never swear allegiance to any emperor or king, nor be obliged either to engage in any expedition against the Romans, or to pay for the privilege of exemption; nor to pay any contributions whatsoever to the empire; nor be in any way reckoned among the cities of the empire. Virtually they were independent republics. Commerce and manufactures gradually increased the importance of the imperial cities and they often ventured to resist their masters, the emperors, and could not be reduced to obedience without great difficulty. In the middle of the 13th century two important confederacies were established for common objects — the Hanseatic League (1241), comprising the cities of Frankfort-on-the-Main, Hamburg, Bremen, and Lübeck, and the league of the Rhenish cities (1246), comprising Cologne, Worms, Mainz, Strasburg, Basel and Spires, which are now incorporated in their respective political divisions. The powerful Hanseatic League lasted nearly four centuries, until its dissolution was effected by several causes in 1630. The remnant of this league and of the former *collegium* of cities, which had its representatives in the German Diet, namely the free cities of Hamburg, Bremen, and Lübeck, was incorporated with the French empire in 1810. As these cities co-operated vigorously in the recovery of German independence, they were acknowledged, together with Frankfort-on-the-Main, as free cities by the Congress of Vienna (1814–15). They joined the German Confederacy, and obtained the right of a vote each in the Diet, and one among the four in the narrower council. In conformity with the 12th article of the Constitution of the German Confederacy, they established a common supreme court of appeal in 1830. Frankfort in 1866 was annexed to Prussia. The only free cities now existing are Hamburg, Lübeck, and Bremen, each sending a member to the Bundesrath, and Hamburg three deputies to the Reichstag, the others one each.

Free Congregations (Ger. *Freie Gemeinden*), sometimes called "Protestant Friends," a sect of German Rationalists, who at first pro-

fessed to be Christians, but now reject the doctrines of miraculous revelation and a personal deity. There are upwards of 120 congregations of them in Germany, and a few in the United States.

Free Negroes, in the United States. At the formation of the Union these numbered about 60,000, nearly half of them in the South; but while there were few slaves in New England, and those dwindling, and less than 50 per cent more than the free colored population north of Maryland, the South had more than 20 times as many slaves as freedmen, and the system was extending. Hence this section began early to dread the free negroes, as an element always making their slaves discontented, and possibly stirring them to revolt; a sentiment deepened into terror after the Santo Domingo massacres. State laws and constitutions were framed or amended to drive them from the States or reenslave them; one method being to forbid emancipation by will, and provide that free negroes must choose masters or leave the State; and another to punish all penitentiary offenses of negroes with reduction to slavery. The Colonization Society (q.v.) derived its first impetus from this feeling, till it was seen to be a mere reinforcement of slavery. The laws for refusing to allow negro merchant sailors to land, or even imprisoning them if they did, also caused much bad blood with the North. The "Black Laws" reached their acme just before the War, as did the personal-liberty laws in the free States. By the Dred-Scott decision, free negroes were not citizens of the United States; which became law and remained so until repealed by the Fourteenth Amendment, though the Thirteenth had abolished slavery.

Free Port, a harbor where ships of all nations may enter and load or unload on payment of harbor dues or charges for accommodation. Goods may be stored at free ports, and may then be either re-shipped for export, or they may be admitted for home consumption on payment of the usual full customs of the country. The bonded warehouse system effects the same end as free ports. See TREATY PORT.

Free Ships, Free Goods. That is, that in time of war, belligerents shall have no right to inquire into anything regarding a vessel and her cargo but whether the former belongs to a neutral, and if so, her cargo must be as free as herself; unless the cargo is agreed contraband of war. This is the doctrine of international law which the countries of predominantly industrial interests have always struggled to have accepted; while those by nature constantly or frequently at war have refused to admit it. In the great wars of France with England, in the Revolutionary and Napoleonic era, the United States was the great champion of this doctrine, while England refused to admit it, claiming the right to confiscate her enemy's goods wherever she found them, and search every neutral for them. The War of 1812 arose partly from this, and did nothing toward settling it; but the close of the war period left it of little practical importance for many years. The Declaration of Paris (q.v.) went farther than this, and proclaimed neutral goods safe even in an enemy's vessels.

Free-soil Party (1848-55). This was the old Liberty party (q.v.) of direct abolition (Birney, Chase, etc.), plus the "Conscience Whigs" of Massachusetts (Sumner, C. F. Adams, etc.), who supported the Wilmot Proviso (q.v.), and the "Barnburners," or Van Buren section of the New York Democrats. The latter as a body adopted their principle of restricting the extension of slavery into the Territories, to punish the Polk administration, ultrasouthern, for attempting to build up its own "machine" in New York at the expense of the Albany Regency (q.v.); but a small element of it was really in sympathy with their less extreme purposes. Van Buren had lost the nomination in 1844 by refusing to approve the annexation of Texas; and his co-operation was more than a mere party move. The Liberty party in 1847 nominated John P. Hale of New Hampshire and Leicester King of Ohio for President and Vice-President; but seeing a chance of larger success through the promising split in the Democracy, dropped them and waited. The Barnburners, offered only an even share of the State vote with their rivals the Hunkers in the Baltimore Democratic convention of 1848, withdrew, and after nominating Van Buren at a bolting convention to keep the party together, agreed to join in a fusion "Free-Soil" party. A convention of this at Buffalo in August nominated Van Buren and Adams. The platform declared for "Free Soil, Free Speech, Free Labor, and Free Men"; and that slavery in the States was beyond the control of Congress, but that as Congress could not make slaves it was bound to refuse it admission to the Territories (see WILMOT PROVISO). The party cast 291,263 votes, turned Maine and six western States over to the Democrats (Cass), and would have defeated the Whigs (Taylor) but that the New York defection (120,510) was mainly from the Democrats and gave that State to the Whigs. The New York Democratic delegation to Congress was annihilated all but one; and the two factions at once struck a bargain, which left Van Buren permanently out of public life. The Free-Soilers in the 31st Congress (1849–51) had 2 United States senators (Chase and Hale), and 14 representatives, including J. R. Giddings, George W. Julian, and Horace Mann. Sumner in the Senate and 3 more representatives reinforced them in 1851, and in the 33d Congress (1853–5) they had 5 senators and 17 representatives. Having been abandoned by their casual allies, in 1852 they nominated Hale and Julian; with a platform denouncing the Compromise of 1850 (q.v.), both the great parties for accepting it, and slavery as "a sin against God and a crime against man," and demanding the repeal of the fugitive-slave law. They polled 156,149 votes, of which 25,329 were in New York. They maintained their organization in Congress till the Kansas-Nebraska Bill (q.v.) had created the Republican party, into which they were at once fused.

Free Sons of Israel, Independent Order of, a Jewish fraternal and benevolent society founded 10 Jan. 1849. It has 3 grand lodges and 103 subordinate lodges in the United States. In 1902 it had a total membership of 11,000, and a reserve fund of $860,000.

Free Spirit, Brethren of the, a sect of heretics which originated in Alsace in the 13th century, and quickly became disseminated over Italy, France, and Germany. They claimed

"freedom of spirit," and based their claims on Rom. viii. 2–14. Thence they deduced that they could not sin.

Free Stone. See BUILDING STONE; SANDSTONE.

Free Trade, in current use restricted to mean the interchange of commodities between countries politically independent, without obstacles specifically intended to restrict the trade. All taxes on imports, which form a large part of the revenue of most civilized governments to that extent impede the freedom of trade; but the essence of the free-trade system is, that they shall not be arranged to "protect" the correspondent home production, or, as free-traders would put it, to divert capital into otherwise unprofitable channels at the expense of the consumer. This is accomplished by selecting articles not possible to produce at home (as tropical products in a temperate country); by forbidding their production at home (as tobacco in England), foregoing certain new home industries for the sake of sparing existent ones; or by laying corresponding internal taxes.

That free trade was never even formulated as a theory till a few generations ago, nor adopted as a policy till within two generations, that it is even now practised in its fulness by only one country, and nearly so by only two more, and that the former, its chief exponent, is at this moment rent by a fierce struggle to resume its old protective system, indicates something more back of this question than the mere state of economic enlightenment. The truth is, free trade is a matter of business, and all states have prior interests which business only subserves, and to which it is sometimes partially antagonistic. National existence always comes first, national prestige usually, national rivalry and jealousy frequently. In the Middle Ages war was the normal condition of most countries and the constant liability of the rest; hence everything had to be subordinated to diversified resources in war, whence a nation's supplies might be suddenly shut off. As the age of neutrality and the localization of wars has supervened, this danger has practically passed; but masses of capital and of labor in each country, which its rulers cannot politically disregard, can still be injured by the hostile tariffs which are the modern substitutes for fleets and armies of conquest. The problem at issue is, whether these injure the target as much as the marksman; free-traders have one answer, protectionists another. But the protectionist interest is always much more concentrated and effective than the free-trade: it is that of masses of capital embarked in certain enterprises and fighting for life, with all the masses of people behind it whom it maintains, and who would be temporarily injured by a readjustment. Protection is led by those who are interested in terms of millions, free trade mostly by those who are interested relatively in terms of pennies. The contest is so unequal that it is only wonderful that any circumstances have ever given the latter even a temporary victory.

In Europe till the 17th century, and in most parts of that till the 18th, the only way the bounds of free trade were extended was by conquest; and even that did not always effect it, old provinces and feudalities retaining their rights to separate custom-houses — primarily an octroi, but used for "protection." Most countries were cut up by dozens of these vexatious boundary lines, crippling all internal trade, and making each little district a special and self-subsistent world. Under Louis XIV. Colbert (1665–83) swept away many of these old provincial barriers, to the enormous development of French industry and trade, and consequently revenue; but he could not touch the chief portion. Already in 1623 De la Croix had propounded the theory of free trade; and in England it was urged in 1696 by Nicholas Barbon, one of the founders of the life-insurance system. But about the middle of the 18th century it sprung into life at once in two quarters, the lesser influence at the time having been vastly more potent in the end: with the French "Physiocrats" and Adam Smith. The theory of the former — whose founder was Cantillon and the chief heads Quesnay and De Gournay — was enthusiastically taken up by a group of able thinkers and men of affairs, and in 1774 put partially in practice by Turgot, in free trade for grain throughout France. Their method of approach was curious: they held that as commerce does nothing but transfer from hand to hand wealth already existing, without creating new, the gains of the trading class are at the expense of the only real wealth, the products of the earth; it is therefore to the community's interest that they should be as small as possible, and to this end commerce should take the shortest and most natural channels, as this leaves the "net product" of society the highest. Meantime in 1752–63, Adam Smith, a professor of moral philosophy at the University of Glasgow, had been working out a theory of the social progress of nations; and, as one branch of it, he investigated the causes of their material well-being. He was anything but a man of business, but he had a Scotch intellect which reasoned truly, and his society included many keen and able merchants and importers of the day. From them and his own mind he produced and fortified the theory that dams in a stream could never create water, but only force it into other channels. He visited France and met the Physiocrat leaders, and received doubtless new arguments and fresh facts. In 1775 he published his 'Wealth of Nations,' perhaps the most epoch-making single book of all time; for it created political economy as a science and free trade as a practical system. He took separately each kind of protective duty in use or advocated, and proved that each did harm in the very line it was supposed to do good. But he saw no hope of free trade ever coming about in England, so dominating was the influence of invested capital and of "furious and disappointed monopolists." But a curious change in industrial affairs inverted the position of his friends and enemies. His views had been favored by the landed interest and disfavored by the manufacturers; but the course of business made the agriculturists eager to keep up the duties on grain, which gave them immense profits; while the manufacturers began to be irked by the duties on raw material, which checked their coming dominance of the textile market under the splendid English inventions. The ablest statesmen were on the same side: Shelburne and the younger Pitt were convinced free-traders,

and the latter tried to put Irish free trade into the act of Union in 1800. Two decades later the adherents were numerous: Ricardo's 'Political Economy' had reinforced Smith's, with greater weight because he was a successful Jewish banker; and London merchants were petitioning to have the shackles taken off trade. The first great success was making William Huskisson president of the board of trade in 1823: he was ignominiously driven from the Cabinet by the Duke of Wellington, but had induced Parliament to free some articles and lighten the duty on others. Thrust aside by more pressing politics, the reform stood still till 1836, when a failure of crops made it once more a burning question. Never was an issue so sharply marked out: the people were sacking the towns for bread while grain was taxed to enrich the landlords. Meantime manufacturers, increasingly the chief reliance of the national revenues, were kept out of foreign markets by having to pay higher for raw materials and more for wages. Local Anti-Corn-Law Associations from 1837 on were fused into the National Anti-Corn-Law League in 1839; at its head were Richard Cobden and John Bright, both partners in Manchester calico-printing works; whence the term "Manchester School" for supposed believers in various doctrines mistakenly attributed to Cobden. The struggle convulsed England, and almost broke the bonds of social order; but the final blow to the old system was the Irish potato famine in 1845. This shortage made food still higher; and Sir Robert Peel, who had taken office expressly to resist the repeal of the Corn Laws, remained in it to repeal them himself, 26 June 1846 — most of the duty at once, the rest by a sliding scale within three years.

The full free-trade policy was not introduced for many years, however: it was Mr. Gladstone in 1869 who framed the present system of absolute freedom from protection, though as Palmerston's chancellor of the exchequer in 1861 he had taken a long step toward it. In 1841 more than 1,000 articles were on the customs list, over half of them large staples; in 1849 they were reduced to 515, and in 1855 to 414, but still 153 main articles of consumption; while in 1861 they were reduced at a blow to 142, of which only 19 were of great importance, and in 1876 to 42, of which 10 were important. They have since been reduced to 12 altogether, in as few classes as possible — seven kinds of drinks, three of sweets, one narcotic and one food; namely, spirits, wine, and beer; tea, coffee, chicory, and cocoa; sugar, molasses, and glucose; tobacco; and dried fruits.

The progress of Great Britain under this system is the very point now in fierce issue, and soon to be passed upon by a fresh election. It may be said here that in the last 30 years of protection, the total increase of British imports and exports was $340,000,000; in the first 30 of free trade it was $2,400,000,000, between seven and eight times as much. In 1816–40 the total increase in British shipping was 80,000 tons; from 1848 to 1858 it was 1,257,000, and thence to 1880 1,917,000 more. The experience of Belgium was even more striking. Under Napoleon prohibitory duties were imposed, and the country became largely depopulated; with the return of the Dutch and low duties, great manufactures at once sprang up; with their expulsion in 1830 high protective duties were again imposed, and in 1851 the prime minister declared that if they were not removed all domestic industry would be ruined; the whole system was swept away in 1855, and Belgium rapidly became, size for size, the foremost industrial and commercial state of the world, the richest per capita, and the manufactory of Europe. Only a few per cent of its revenue is from imports, the rest being from internal duties.

The arguments for free trade cannot be stated without those against protection, being the same. They are not alone industrial, but political and social. Broadly, it is asserted that protection cannot increase the total industrial product to be divided up, and can only enable one class of the community to force the remainder to buy one costly article instead of two cheap ones, thus lessening the volume of trade and production; that its claim, to redistribute the amount in wages is false, as but for the system the same capital would have been employed in other industries and paid as much wages, with lower prices to the consumers; that its claim to ultimately reduce prices is false, because as soon as that object has been achieved, it applies to the government on that very ground to save it from ruin by increasing the duty; that its claim to found industries is false by demonstration; and that it narrows instead of diversifying them; that it extorts high prices from home consumers by squeezing the market of which it is given a monopoly, and then sells its surplus to foreigners at a low price — which Adam Smith sets down as inevitable with a protective system; that it produces trusts, to prevent competition through which the public might secure its alleged benefits; that it produces alternate "feast or famine," inflation and panic, instead of equable business; that it makes orderly public finance impossible, by creating huge random revenues to be spent at random, in place of a calculable budget; that it corrupts politics deeply and hopelessly, by making masses of capital dependent on legislation for its profit, and consequently influencing that legislation for its own ends, stripping the treasury to prevent repeal of duties, inventing extravagant schemes to spend an unnecessary revenue, and buying votes in its favor by enormous permanent burdens on the people, through pensions and the like; that the low tone of American public life, wherein men can remain and be honored after exposures which would drive them into permanent obscurity in any European country, is mainly due to this money power created by legislation. For the opposite side, see PROTECTION.

Free Will. This question is properly divided into two sections, that of the metaphysical basis and the doctrinal application; but the latter has so deeply affected the reasonings on the former, that it is almost impossible to separate them.

The metaphysical problem is unique, from its presenting at the outset an irreconcilable contradiction between the phenomena of consciousness and the operations of reason. In this respect it is different from the insoluble problems of time and space, where the conflict is between opposing conclusions of the reason with regard to the materials furnished by consciousness;

here there is a denial, by reason, of the validity of those materials. Consciousness appears to show us at every moment that we can dictate our actions mostly and our thoughts very largely; reason tells us that each follows on other phenomena, from whose invariable relation of precedence we characterize them as cause and the former as effect. Consciousness tells us that our will is the active agent in producing the phenomena which immediately succeed it; reason tells us that this fancied agency is an illusion and itself a part of the chain of sequences, and that the apparent relation is because, as Hobbes says, the so-called will is the last wish of the mind before determining. But what causes the determination? This involves the problem of the nature of the will as before, as well as of the «coupling-pin» by which, if a reality, it acts on matter; if not a reality, the reason why a mental resolve is invariably followed by a physical movement or mental conception. Of the coupling-pin no acceptable theory has ever been framed; the best explanation of the association of will and act, supposing the former an illusion, is still Spinoza's, that they are twin phases of the same ultimate reality, and of necessity change coincidently. But this leaves it still unexplained why our consciousness makes the will not coincident with the act, but invariably its predecessor: we do not will and act simultaneously, but in succession. The overwhelming weight of reason, however, for 2,500 years, from the Greek predecessors of Aristotle to Jonathan Edwards, has won reluctant acceptance to the doctrine of universal determinism, or in theological phrase, of necessitarianism: a chain of causation extending to all things and back to infinity, since no uncaused first act or idea can be fancied except as part of the First Cause of the universe. It is of course never claimed that all acts are volitional or all volitions deliberate, but only that the mind at will can interject uncaused determinations among the caused. It is evident, however, that to assume the possibility of uncaused acts is to consign the universe to chaos and abolish the reign of law; that only on the theory of strict and unbroken causation (or «invariable sequence») can we reason at all concerning phenomena; that the mind must follow the same law as other entities, and has no power, nor could even be endowed with such by omnipotence, of willing without motive — that is, without a cause itself the resultant of an endless series of other causes. Indeed, as Prof. Huxley puts it, for the mind to cause itself implies that it has anteceded itself, which is absurd: the first mental action must have been part of the chain of causation, which surrenders the whole case, as there is no spot where it can be imagined that it was able to throw down the ladder by which it had climbed, and cut loose from causes into a region of caprice.

To avoid this conclusion, a curious dilemma — usually known as «Buridan's Ass,» though Buridan did not devise it — was invented by the mediæval schoolmen. Suppose an ass between two bundles of hay, exactly alike, and with no motive for choosing which to bite first: it is absurd to suppose he would starve in the midst of food, and he must therefore act from free will. To this, however, it was answered that if motiveless he would so starve; and the question remained as before.

Involved with this is the question of God's foreknowledge. It is obvious that this involves his pre-determination of events, as otherwise he would foreknow what was never to happen, or was to happen outside his will; and there can be no change in the predestined order, since any change in a sequence must itself be part of the predestination and foreknowledge.

Alone of all metaphysical questions not incident to the claims of religious founders, this has always been a fierce battle-ground, the dividing line of great religious sects. The reason is that the possibility of sanctions for moral law, and consequently of a decent basis for human society, is believed to depend upon it. Determinism seems to cut the roots of moral obligation, by removing the possibility of obedience to it. If we are without will except as a consciousness of preference resulting from causes outside our control, we are automata; and preaching obligation of any sort to us seems as irrational as preaching it to a doll, for our action will not be influenced by it, nor are we responsible for disobedience. In this extreme form, the fallacy is easily apparent. The will, as Edwards has put it, always follows the greatest seeming good: but its estimate of good is not an unvarying thing, but constantly changing with experience and reason. Now moral rules, apprehended and accepted by the mind, form a part of this good, and therefore become new causes which determine the will: and whatever may have been the causation which has determined the evolving and enforcing of the moral law, it is nevertheless a portion of the environment which acts on the mind. As to responsibility, the question is irrelevant. An automaton which runs into a fire or the sea perishes none the less than if the act were a conscious volition. Punishment waits not on responsibility, but on violation of the laws of its being, and blame as excuse are alike impertinent to the result. We do not blame a child who burns its fingers, but the fingers are in the same condition as if we did.

Back of this, however, lies a contradiction of fact. So far from determinism making moral law impossible, free will makes it impossible. If volition can perpetually nullify the action of motive, there is a fatal breach in the continuity of cause and effect; there can be no calculable sequence of action and therefore no law. The most perverse defiance of natural order is no more independent of cause than the steadiest obedience, for that perversity is itself due to causes precedent. Whence then come the invariable consciousness of freedom to act, its universal recognition, its embodiment into the framework of society, the obvious fact that there can be no society except on this basis? Why, here again, do consciousness and practice oppose themselves unalterably to invincible argument? Edwards explains that though we have not liberty of willing, we have liberty of action; which taken literally would imply that the will has no necessary connection with the act, and that we may voluntarily do a thing we have involuntarily willed not to do. Of course Edwards does not in fact maintain this, but only that God has given a choice of action by furnishing experience and reason and illumination by which to frame correct determinations. Waiving discussion of the difference between

these determinations and will, the real explanation probably lies in the confusion between the abstract and concrete will, between its dependence on causes and, as above said, our own power to determine or change those causes. Instruction, example, appeals to self-interest or fear, or vanity, or affection, or honor, etc., produce an evironment and modify the view taken by each of the supreme immediate good, calculably enough to base coherent society upon; where their effect is grossly miscalculated the society goes to pieces. Metaphysics and the general consciousness are both right, each in its own sphere: the will must have motives, but those motives are furnished in great measure externally. Furthermore, subject to the inexorable limitation, it can furnish by its own action motives to change itself; and constantly does so, attributing to its independent action what is really due to the influence of the new causes it has made to operate in altering its estimate of relative good. For the purposes of human life, volition is absolute and there is no injustice in enforcing responsibility.

Freedman. See FREEMAN.

Freedmen's Bank, a savings bank chartered by Congress in the District of Columbia in 1865, at the special instance of Charles Sumner and Charles R. Buckalew, as a means of encouraging thrift among the newly emancipated negroes. It was in fact intended as part of the Freedmen's Bureau work, and had among its corporators Gen. Howard, the chief commissioner, and a host of the most eminent and upright public men and philanthropists; and its investments were restricted to government securities. It started branches in some 30 Southern cities, with doubtful legality, but covered by the elastic ægis of the bureau's power and every one's good will, the South's most of all; and did a large business. But the corporators appointed successors much less disinterested; the restriction on investments was removed in 1870, ostensibly to benefit depositors by a higher rate of interest, against the protest of Simon Cameron in the Senate; the securities were rapidly replaced by "wildcat" stocks, all speculative and mostly worthless, and by mortgages on valueless property; and in 1874 the bank was pronounced insolvent, with practically no assets. The blow to incipient negro thrift was very great; and the scandal discredited the entire system of which the bank was an outcome, and was one cause of the political overturn in 1874.

Freedmen's Bureau, 1865-9. The supervision, temporary maintenance, and employment of the mass of homeless, penniless, and untaught freedmen created by emancipation, was an obvious duty of the government, urged upon it at once after the proclamation of 1 Jan. 1863; and in 1863-4 officials were appointed to lease abandoned lands to them for not exceeding a year. The military officers left much of the care and provision for freedmen in their hands; but a more comprehensive plan was needed, and after various abortive efforts at an acceptable measure, a "Bureau of Refugees, Freedmen, and Abandoned Lands" was established in the War Department 3 March 1865, to continue for a year after the war. It was to be headed by a commissioner, with assistant commissioners in all the seceded States; to issue supplies to destitute freedmen, have charge of abandoned lands to lease and ultimately sell in 40-acre plots, and have "control of all subjects relating to refugees and freedmen"— an elastic provision construed in the most elastic way. Its commissioners — the head being Gen. O. O. Howard (q.v.), a noble-minded and laborious philanthropist — acted as courts of law where there were none, or where negroes were not recognized as free; established the institution of marriage, and kept records; assured the freedmen the right to choose employers, and made fair contracts for them. The "abandoned lands" disappeared under the amnesty acts; but the bureau did excellent work by inaugurating free schools on a large scale. On 6 Feb. 1866 Congress passed a bill to enlarge its powers and make it permanent; Johnson successfully vetoed it, but on 16 July another was passed over his veto, extending the bureau to July 1868, later extended a year in unreconstructed States. Under this its sweeping powers made it largely the government of the South under Reconstruction, especially as the department military commanders were usually made assistant commissioners; and the demoralizing and disastrous struggle of the North to secure negro independence, and of the South to reassert white mastery, is a history of part of the bureau's action — through executive and legislative powers scarcely pretended to be constitutional, and to transfer which to the regular courts the Fifteenth Amendment was passed. Better features of its work were the foundation of the free public schools in the South, and of Fisk, Howard, and Atlanta universities, and Hampton Institute; of the system of negro peasant proprietorship; and the winning of equal rights for all men in the courts. That it failed in its larger hopes, and that its harmful results were so great that many hold them far in excess of its benefits, are facts attributed by the fairest judges to the inevitable conditions of the problem. (See a very lucid and singularly just summary by W. E. B. DuBois — colored — in the 'Atlantic Monthly,' Vol. LXXXVII., p. 354.) The bureau ended its main work in 1869: its educational work continued till 1872, and bounty payments some years longer. It had about 900 agents in 1868; and expended in all some $20,000,000, over $10,000,000 on objects unconnected with soldiers' bounties. Gen. Howard published a report of its work in the House Executive Documents, 41st Congress, 2d session.

Freedom, or **Freedom of the City,** an English custom occasionally revived in America. The freedom of a city or borough is the right of enjoying the privileges and immunities that belong to the burgesses or freemen, such as electing the council or the parliamentary representative. In certain boroughs there were at one time freemen by birth or marriage not on quite the same footing as burgesses.

Freehold, N. J., town, county-seat of Monmouth County; on the Central R.R. of New Jersey, and the Pennsylvania R.R.; about 32 miles southwest of Jersey City. It was settled in 1734, and for some time it was called Monmouth Court House, because of the county court being held in the village. In 1869 it was incorporated. It is the trade centre for a large agricultural section. Its chief manufactures are bicycles, foundry, and machine-shop products,

underwear, and shirts. One of the attractions of the town is the granite monument in memory of the battle of Monmouth (q.v.) which took place here 28 June 1778. Pop. (1900) 2,934.

Freehold, in English and American law, an estate or real property held in fee simple in America, or in England either in fee simple or fee tail; the tenure by which such an estate is held. (See FEE.) Anciently it was one of the two chief tenures known as tenure in free socage, and was the only free method for laymen to hold property. A freehold estate must possess immobility, in other words, must consist either of land or of some interest arising out of land annexed to it. Secondly, it must be of indeterminate duration.

Freeland, Pa., borough in Luzerne County; on the Lehigh Valley R.R.; about 30 miles southwest of Scranton. It is situated in the anthracite coal region, but it is surrounded by a large section of good farming land. The chief manufactures are lumber, mining and farm implements, and foundry products. During the last decade the place has increased rapidly in population and manufacturing. Pop. (1890) 1,730; (1900) 5,254.

Freeman, Alice Elvira. See PALMER, ALICE FREEMAN.

Freeman, Edward Augustus, English historian: b. Harborne, near Birmingham, 1823; d. Alicante, Spain, 16 March 1892. He was educated at Trinity College, Oxford, where he obtained a scholarship in 1841, and after his marriage in 1847 he retired to a small estate at Somerleaze, in Somerset, where he devoted himself to literature. His first publication (1849) was a 'History of Architecture,' a subject in which he maintained interest throughout his life. This work was more especially devoted to Gothic architecture. His architectural researches helped to turn his attention to history, but his earliest historical works were the product of his interest in contemporary burning questions. His 'History and Conquests of the Saracens' (1856) was partly due to the Crimean war; and the American Civil War brought forth his 'History of Federal Government' (1863), which, however, remained a fragment in one volume. Between 1867 and 1879 appeared his *magnum opus*, the 'History of the Norman Conquest of England,' in six volumes, followed in 1882 by two supplementary volumes dealing with 'The Reign of William Rufus and the Accession of Henry I.' In 1884 he was appointed regius professor of modern history at Oxford, and this post he occupied till his death. His last great work was a 'History of Sicily,' which he left unfinished, though three volumes of the work were published. He died in Spain, where he was traveling for the purposes of recreation and research. Other works of his beside those mentioned were: 'Church Restoration' (1849); 'Essay on Window Tracery'; 'The Architecture of Landaff Cathedral'; 'History of Wells Cathedral' (1870); 'Old English History' (1869); 'Growth of the English Constitution' (1872); 'Historical Essays' (three series, 1872-79); 'The Ottoman Power in Europe' (1877); 'Historical Geography of Europe' (1881); 'Sketches from the Subject and Neighbor Lands of Venice' (1881); 'Lectures to American Audiences' (1882); 'English Towns and Districts' (1883); 'Some Impressions of the United States' (1883); 'Exeter' (1887); 'Methods of Historical Study' (1886); 'The Chief Periods of European History' (1887); 'William the Conqueror' (1888). He was a man of strong partisan feeling, with a firm belief in the superiority of the Teuton which sometimes interfered with a judicial weighing of evidence. But he took great pains to verify his facts, indeed was devoted to truth, and had a wide and deep knowledge of history. In spite of his pugnacity and the obstinacy with which he maintained his side in a controversy he was a man of generous and kindly nature. Consult 'Life and Letters,' by Stephen (1895).

Freeman, James, American Unitarian clergyman: the first in the United States to assume the name Unitarian: b. Charlestown, Mass., 22 April 1759; d. Newton, Mass., 14 Nov. 1835. He was graduated from Harvard in 1777, in 1782 became lay-reader in King's Chapel, Boston, later proclaimed himself an Unitarian, and, supported by his congregation secured corresponding changes in the Prayer-book. In 1787, his bishop having refused him ordination, he was ordained by his wardens and congregation. Until his death he was rector of the chapel. He published: 'Sermons and Charges' (1832).

Freeman, James Edward, American artist: b. Nova Scotia 1808; d. Rome, Italy, 21 Nov. 1884. He was a pupil of the National Academy of Design, and was elected national academician in 1833. From 1836 his studio was in Rome. His works, largely portraits and genre subjects, are skilful in color and display attention to technical detail. They include: 'Young Italy'; 'Peasants on the Sands of the Sezchio'; 'The Beggars.'

Freeman, James Midwinter, American Methodist clergyman: b. New York 29 Jan. 1827; d. 1900. He was educated at Wesleyan University, and ordained to the ministry of the Methodist Episcopal Church, of whose Sunday-school Union and Tract Society he became secretary and editor in 1872. He was the author of 'Use of Illustration in Sunday-school Teaching' (1867); 'Hand-book of Bible Manners and Customs' (1874); 'Short History of the English Bible' (1879).

Freeman, Mary Eleanor Wilkins, American novelist: b. Randolph, Mass., 1862. She was educated at Mount Holyoke Seminary and after some years spent in Brattleboro, Vt., returned in 1883 to Randolph, which remained her home till her marriage to Charles Freeman in January 1902, when she removed to his home in Metuchen, N. J. She came first into notice about 1886 by her extremely faithful delineations of certain phases of New England life in her short stories contributed to the magazines. After some years she attempted more sustained work, and within the last ten years has published several novels, displaying the same characteristics as her short stories, as well as skill in the handling of plot, and dramatic vigor. Her work has steadily gained in popularity and has been greatly admired by English as well as American critics. A fondness for very short sentences gives her work almost a staccato character at times, and it must be said that while the accuracy of her studies of New England village existence cannot be called into question, her insistence upon the bareness of the life to the

exclusion, or almost entire subordination of its happier phases, conveys a not wholly correct impression of the life in its entirety. Her published works include: 'The Adventures of Ann' (1886); 'A Humble Romance and Other Stories' (1887); 'A New England Nun, and Other Stories' (1891); 'Young Lucretia' (1892); 'Giles Corey, Yeoman,' a drama (1893); 'Jane Field,' her first novel (1893); 'Pembroke' (1894); 'The Long Arm,' with J. E. Chamberlin (1895); 'Jerome, a Poor Man'; 'Silence and Other Stories'; 'The People of Our Neighborhood'; 'Understudies'; 'Madelon'; 'The Love of Parson Lord'; 'Evelina's Garden'; 'The Wind in the Rose-Bush'; a series of ghost stories (1903); etc.

Freeman, Nathaniel, American jurist: b. Dennis, Mass., 1741; d. 1827. In 1763 he became resident at Sandwich. He fought in the Revolution, and was brigadier-general of militia forces in 1781–91. In 1795–99 he was a member of the United States Congress, and he also sat in the Massachusetts legislature, and was for many years judge of the court of common pleas. He was also a medical practitioner, and an orator of some distinction.

Freeman, or **Freedman,** is one who has inherited the full privileges and immunities of citizenship; one who has been delivered from the restraints of bondage, but who, usually, is not placed in a position of full social or even political equality with him who was born free. In old Rome, the equivalent for freeman comprehended all classes of those who were not slaves. As the organization of Roman society survived the convulsions of the Middle Ages to a far greater extent in the towns than in the landward districts, where the institutions of feudalism (q.v.) almost entirely superseded it, it is in the borough and other municipal corporations of Europe that we still find freemen, or persons inheriting or acquiring by adoption, purchase, or apprenticeship the rights of citizenship. In the United States the term freemen was used of the colored people emancipated by the Civil War. The duty of caring for those people, finding them work, and preparing them for the privileges of freedom was thrown on the War Department; and in 1865 an act of Congress created in that department the bureau commonly known as the "Freedmen's Bureau" (q.v.), whose duties practically ceased in 1870. The founding of several institutions for colored persons, such as Howard University and Fisk University (q.v.), was a permanent result of its work, out of which have grown other educational achievements of great importance in the advancement of the colored people.

Freemasonry. See MASONIC FRATERNITY.

Freemasons. See MASONIC FRATERNITY.

Freeport, Ill., city, county-seat of Stephenson County, on the Pecatonica River, the Illinois C., the C. & N., and the C., M. & St. P. R.R.'s; about 105 miles northwest of Chicago, and 55 miles southeast of Dubuque. It was settled in 1835 and received its charter in 1855. The "Freeport heresy," a political doctrine much discussed before the Civil War, was that regardless of the Dred Scott case (q.v.) any Territory had the right to reject the slave system by the means of police laws which would be "unfriendly," and would in time stamp out the existence of slavery. This "doctrine" or "heresy" was advanced by Douglas in the famous debate with Lincoln which took place in Freeport in 1858. The chief manufactures are wind-mills, bicycles, organs, wagons, and toys. It has coffee-mills and railroad shops. It contains a free library, St. Francis Hospital, a good system of public and parish schools, and several fine public buildings. Pop. (1900) 13,258.

Freer, Paul Caspar, American chemist: b. Chicago, Ill., 27 March 1862. He was graduated in 1882 at the Rush Medical College of Chicago; at the University of Munich, Germany, in 1887; was assistant in Owens College, Manchester, England, in 1887; and an assistant and instructor in Tufts College in 1887–9. In 1889 he became professor of general chemistry in the University of Michigan. He has published: 'A General Inorganic Descriptive Chemistry' (1895); 'The Elements of Chemistry' (1896); and numerous pamphlets.

Freethinker, a name assumed by those who, disbelieving in revelation, feel themselves free to adopt any opinion in religious or other matters which may result from their own independent thinking. The name was specially claimed by those who in the 17th century took part on the anti-Christian side in the deistic controversy. Voltaire (q.v.) was a well-known French freethinker.

Freetown, Africa, a seaport of West Africa, capital of the British colony of Sierra Leone, on the south side of the river of Sierra Leone. Its principal streets are broad and straight, and have, more especially in the part occupied by Europeans, a very attractive appearance, the houses being generally detached and surrounded by trees. Freetown is a strongly fortified imperial coaling-station. A railway runs from Freetown some distance into the interior. Pop. (1901) 34,463.

Freezing, Congelation, or **Solidification,** the transformation of a liquid into a solid under the influence of cold. Each liquid always solidifies at the same temperature, which is called its freezing point, and the solid also melts again at the same temperature. Thus the freezing point and the melting point, or point of fusion, are the same, and the point is always the same for the same substance. The freezing point of water, or the melting point of ice (32° F.), is taken for one of the fixed points in thermometry. The freezing point of mercury is 39° below zero, of sulphuric ether 46° below zero, of alcohol 203° below zero F. It has been shown that the increase of pressure on water, and on all substances which expand in freezing, will lower the freezing point; and that such substances as wax, spermaceti, sulphur, and paraffin, which contract in freezing, have the freezing point raised by pressure. See MELTING-POINT.

Freezing-mixture, a mixture for the production of artificial cold. For this purpose two substances are mixed, of which one is usually solid, and which tend to form a liquid mixture. In liquefying any solid a certain amount of heat is made latent, and owing to this the temperature of the mixture at the end of the liquefaction is often very low indeed.

Thus on mixing snow and salt together the salt converts the snow into water, or rather tends to form brine; but snow cannot melt without making latent a considerable quantity of heat. Hence the temperature of the brine which is the result of the mixture is very much below that of either the salt or snow. The fact is that salt and water mixed cannot be in the solid condition, except at a temperature very much below that of ordinary snow. The following is a list of freezing-mixtures, and of the lowering temperature obtained by means of them. The substances, with the exception of the ice, mentioned in the second, are supposed to be mixed together at 10° C. (50° F.). Such mixtures are often employed in the making of ice-cream or water-ices, for cooling wine, etc. See ICE, ARTIFICIAL; REFRIGERATING MACHINES.

Substances	Parts by Weight	Reduction of Temperature
Sulphate of sodium..	8	+ 10° C. (+ 50° Fah.) to − 17° C. (+1° Fah.)
Hydrochloric acid....	5	
Powdered ice or snow	2	+ 10° C. to − 18° C. (0° Fah.)
Common salt........	1	
Sulphate of sodium..	3	+ 10° C. to − 19° C. (− 2° Fah.)
Dilute nitric acid....	2	
Sulphate of sodium..	6	+ 10° C. to − 26° C. (− 15° Fah.)
Nitrate of ammonium	5	
Dilute nitric acid....	4	
Phosphate of sodium.	9	+ 10° C. to − 29° C. (− 20° Fah.)
Dilute nitric acid....	4	

Freezing Point, that temperature at which the solid and fluid states of a substance can co-exist in a state of permanent equilibrium. For water, this temperature is 32° F., or 0° C. For the freezing points of other substances, consult the articles in which their general properties are described. See also HEAT; MELTING POINT; SOLUTIONS; THERMODYNAMICS; THERMOMETRY.

Freiberg, frī'bĕrg, Saxony, a mining town 19 miles from Dresden. It is the capital of the mining district of Saxony, and contains a mining academy founded in 1765, with 13 professors, fine scientific collections, among which is the celebrated collection of precious stones amassed by Werner, and a large library. There is a fine relic called the Golden Portal belonging to the ancient Church, which stood on the site of the Gothic cathedral. It is an ancient imperial city, and is still surrounded by the old walls and ditch. The town owes its origin to the discovery of silver mines in the 12th century. Here, on 29 Oct. 1762, Prince Henry of Prussia defeated the allied Austrian and Saxon army. Pop. (1900) 30,175.

Freiburg, frī'boorg, or **Freyburg,** or **Freiburg im Breisgau,** Baden, a town in the circle of the upper Rhine, on the Dreisam, and on the railway from Carlsruhe, in one of the most beautiful and fertile districts of south Germany, at the west foot of the Black Forest. It consists of the town proper, the fortifications of which have now been converted into pleasure-grounds, and of two suburbs, and is the seat of a superior civil and criminal court, and of several public offices. The buildings most deserving of notice are the münster or cathedral, a large and beautiful Gothic structure built of red sandstone, admired for its delicate symmetry and tasteful decorations, with a magnificent portal richly sculptured, and surmounted by a tower, partly of exquisite open work, 380 feet high; the university, founded in 1456; the merchant house, now the chief tax office, a quaint Gothic structure, resting on pointed arches, and decorated externally with fresco portraits of the Emperor Maximilian, his son Philip I., Charles V., and Ferdinand I.; and the grand-ducal palace and government buildings. Freiburg is the see of an archbishop, and the seat of the courts and offices for the circle of the upper Rhine. Pop. (1900) 61,506.

Freiburg. See FRIBOURG.

Freight, formerly a charge paid to the owner of a ship for the carriage and safe delivery of goods; but the term now extends to transportation by land, especially on railroads. In cases of maritime freight, a person chartering a ship pays freight for the goods sent by it, and dead freight in respect of any deficiency of cargo; the terms of the agreement are fixed by the charter party. A person sending goods by a general ship pays freight for them; and the contract takes the form of a bill of lading. So far as the rights of parties are not made the subjects of positive stipulation in the contract of affreightment, they are ascertained with reference to the usage of trade. The carrier's duty is to have the ship ready to start at the time appointed, and to receive the goods and carry them to their destination; having performed these duties, he has a lien on the goods and a right of action in case of non-payment of freight. The shipper's duty is to have his goods forward in time. Freight is not usually payable unless the voyage is completed; but it is sometimes prepaid, in whole or in part, at the risk of the shipper. See BILL OF LADING; CARRIER, COMMON; CHARTER; TRANSPORTATION.

Freiligrath, frī'lig-rät, **Ferdinand,** German poet: b. Detmold 17 June 1810; d. Cannstadt, Würtemberg, 17 March 1876. In 1838 he published at Mainz a volume of his collected poems, and as it proved successful he determined to devote himself entirely to literature. In 1842 he received a small pension from the king of Prussia; but this he retained for only two years, for having embraced views in politics of an advanced liberal stamp which placed him in opposition to the government, he felt bound to resign the benefits of royal favor. At the same time (1844) he published a poem entitled a 'Confession of Faith' (Glaubensbekenntnis), in which he became the champion of the political creed he had adopted. In 1848 other three political poems by him: 'Die Revolution'; 'Februarklänge'; and 'Die Todten an die Lebenden,' saw the light; and the last of these led to his being put on trial for treason. This trial, in which he was acquitted, is memorable for another reason, being the first jury trial ever held in Prussia. From 1851 till 1867 Freiligrath resided in England as manager of the London branch of a Swiss banking establishment. On the failure of the bank a national subscription was got up in his behalf in Germany, and the proceeds of it enabled him to return to private life. The early poems of Freiligrath are distinguished by a wealth of glowing and highly-colored imagery, and by the prevalence of Oriental scenes and subjects. His political poems are too full of the tones of party warfare to live as poetry; but many of his lyrics seem destined to hold an

abiding place in German literature. Germany is also indebted to him for many admirable translations from foreign languages, as from Burns, Tannahill, Moore, Hemans, Shakespeare, Longfellow, and Victor Hugo.

Freire, frā'rĕ, **Ramon**, Chilean general: b. Santiago 29 Nov. 1787; d. there 9 Dec. 1851. He was a grandson of Freire de Andrada (q.v.). He fought in the patriot army in the war for independence (1811–20), and defeated Benevides at Concepcion 27 Nov. 1820. He became the leader of the Liberals, and upon the deposition of O'Higgins in 1823, supreme director, with dictatorial powers. In 1826 he ended Spanish rule in Chile by expelling the remaining Spanish forces from Chiloé in 1826. He was re-elected supreme director in 1827, but resigned not long after. The Conservatives having gained control, he led an insurrection against them, was defeated at Lircai (1831), and banished to Peru, whence return was not permitted him until 1842.

Freire de Andrada, dā än-drä'dä, **Gomes**, Portuguese colonial administrator: b. Coimbra 1684; d. Rio de Janeiro 3 Jan. 1763. He served in the Portuguese army, and became governor and captain-general of Rio de Janeiro in 1733, his authority extending over most of southern Brazil. His administration of almost 30 years was the most successful and prosperous, as well as the longest, in the colonial annals of Brazil. The gold mines were effectively worked, and colonization was greatly furthered. Freire de Andrada was made Count of Bobadilla in 1758.

Frejes, **Francisco**, frän-sēs'kō frā'hĕs, Mexican historian: b. Guadalajara, Mexico; d. 1845. He was trained for priestly and monastic life, became known as a Franciscan of remarkable eloquence, but retired from publicity in 1838, and eventually became superior of the monastery of Guadaloupe, near Zacatecas, Mexico. His object in his retirement was the prosecution of historical study, and his work: 'Historia Breve de la Conquista de los Estados Independientes del Imperio Mejicana,' is a valuable authority on the subject it treats.

Frelinghuysen, frē'lĭng-hī-zĕn, **Frederick**, American lawyer: b. Somerset County, N. J., 13 April 1753; d. 13 April 1804. He was graduated at the College of New Jersey in 1770; studied law, and was admitted to the bar in 1773. Two years later he was chosen a member of the Provincial Congress of New Jersey. He was a member of the Continental Congress much of the time during the Revolutionary War; served as a captain in the army; filled various State and county offices; led an expedition against the western Indians in 1790; and was United States senator 1793–6.

Frelinghuysen, Frederick Theodore, American statesman: b. Millstone, N. J., 4 Aug. 1817; d. Newark, N. J., 20 May 1885. He was a nephew and adopted son of T. Frelinghuysen (q.v.). He was graduated at Rutgers College in 1836, and became an eminent lawyer. He was attorney-general of New Jersey 1861–6; United States senator in 1868–77; and secretary of state under President Arthur in 1881–5.

Frelinghuysen, Theodore, American lawyer: b. Millstone, N. J., 28 March 1787; d. New Brunswick, N. J., 12 April 1862. He was a son of F. Frelinghuysen (q.v.). He was graduated at the College of New Jersey in 1804; and admitted to the bar in 1808. In the War of 1812 he commanded a company of volunteers, and in 1817 became attorney-general of New Jersey, which office he held till 1829 when elected United States senator. He was chosen chancellor of the University of New York in 1838; was nominated for vice-president of the United States in 1844; and in 1850 became president of Rutgers College.

Fremantle, Australia, the chief seaport of Western Australia, at the mouth of the Swan River, 12 miles from Perth. The manufactures include aërated waters, boots, soap, furniture, confectionery, etc. Pop. of town and suburbs (1901) about 22,200.

Frémont, Jessie Benton, American author: b. Virginia 1824; d. Los Angeles, Cal., Jan. 1903. She was a daughter of Thomas H. Benton (q.v.), and married John C. Frémont (q.v.) in 1841. She published: 'Story of the Guard: a Chronicle of the War,' with a German translation (1863); 'A Year of American Travel'; 'Far West Sketches'; a sketch of her father prefixed to her husband's memoirs (1886); 'Souvenirs of My Time' (1887); 'The Will and the Way Stories.'

Frémont, John Charles, American soldier and politician: b. Savannah, Ga., 31 Jan. 1813; d. New York 13 July 1890. He was of mixed French and Virginian parentage. In 1833 he was appointed teacher of mathematics on board the United States sloop of war Natchez, with which he proceeded on a cruise to South America. On his return he turned his attention to civil engineering, and in 1838–9 undertook the exploration of the country between the Missouri River and the British frontier. Shortly afterward, he proposed to the government to undertake the exploration of the Rocky Mountains — at that day a terra incognita. His plan being approved, he, in 1842, started with a handful of picked men, and reached and explored the South Pass. Not only did he fix the locality of that great defile but he defined the astronomy, geography, botany, geology, and meteorology of that region, described the route since followed, and designated the points upon which a line of United States forts were subsequently erected. In 1845 he cleared the north part of California of Mexican troops, and then, seeking a broader field of activity, planned an expedition to the distant Territory of Oregon. He approached the Rocky Mountains by a new line, scaled the summit south of the South Pass, deflected to the Great Salt Lake, pushed investigations right and left his entire course, and at the same time connected his survey with that of Commodore Wilkes' exploring expedition. Later in the winter, without adequate supplies, or a guide, he traversed the wilderness to the Rocky Mountains. In this daring expedition he crossed 3,500 miles of country in sight of eternal snows, discovering the grand features of Alta California, its great basin, the Sierra Nevada, the valleys of San Joaquin and Sacramento, and determined the geographical position of the west portion of the North American continent. In 1846 he was promoted military commandant and civil governor of the Territory of California, in which capacity he in 1847 concluded those

articles of capitulation by which Mexico conceded exclusive possession of that territory to the United States. In 1853 he undertook a fifth expedition across the continent, made new discoveries, and reached California after enduring almost incredible hardships. In 1856 he was the first candidate of the Republican party for the presidency; and in 1861, on the outbreak of the Civil War, was appointed a major-general of volunteers. He then, as commander of the Western Union army, marched into Missouri with the view of encountering Gen. Price's Confederate force then in possession of that State, but an unfortunate dispute with a subordinate officer caused the War Department to relieve him of his command. He was governor of Arizona 1878–81. His publications include: 'Report of the Exploring Expedition to the Rocky Mountains in 1842, and to Oregon and North California in 1843–44'; 'Col. J. C. Frémont's Explorations'; and 'Memoirs of My Life.'

Fremont, Neb., a city and the county-seat of Dodge County, in the central eastern part of the State, on the Fremont, E. & M. V., the Union P., and the Sioux C. & P. R.R.'s, 37 miles northwest of Omaha. The town was settled in 1857 and was incorporated in 1871; it has a telephone system, gas works, and a municipal water supply and electric lighting plant. It is an important market for horses, cattle, sheep, and swine, and has pork-packing establishments, flouring mills, and planing mills. The educational institutions include a normal school and a business college. Pop. (1900) 7,241.

Fremont, Ohio, city, county-seat of Sandusky County; on the Lake Erie & W., the Lake Shore & M. S., and other railroads, and at the head of navigation on the Sandusky River, 30 miles east of Toledo. It occupies the site of a trading post established in 1785, and of Fort Stephenson built in 1812. In 1813 it witnessed the defeat of a body of British and Indian troops under Gen. Proctor, who were repulsed by Maj. George Groghan with 150 men, the British having 94 killed and wounded, and the Americans 1 killed and 7 wounded. In 1850 its former name of Lower Sandusky was changed in honor of J. C. Frémont. It is a busy agricultural and industrial centre with neighboring oil and natural-gas fields, and manufactures machinery, cutlery, agricultural implements, electro-carbons, woolens, beet-sugar, doors, sashes, etc. Steamers connect the city with the principal ports of Lake Erie and carry on a considerable trade. The city has street railways, gas and electric lighting, municipal waterworks and maintains several public parks. The educational institutions include normal and business schools, and the Birchard Public Library, founded by an uncle of ex-President Hayes, whose home here — Spiegel Grove — is occupied by members of the family. Pop. (1900) 8,439.

French, Alice («Octave Thanet»), American novelist: b. Andover, Mass., 19 March 1850. She was educated at Abbot Academy in her native town and has since lived in Iowa and Arkansas, her works reflecting the local color of both States. She has published: 'Knitters in the Sun: Short Stories' (1877); 'Otto the Knight and Other Trans-Mississippi Stories' (1891); 'Stories of a Western Town' (1893); 'An Adventure in Photography'; 'Expiation' (1890); 'We All' (1891); 'A Book of True Lovers' (1893); 'The Heart of Toil'; 'Man and His Neighbors'; etc.

French, Daniel Chester, American sculptor: b. Exeter, N. H., 20 April 1850. He was educated in Boston and in Florence, Italy; had studios in Boston and Concord, N. H., 1878–87, and in New York city 1887–1900. His principal works include: 'The Minute Man of Concord'; statues of Gen. Cass, Rufus Choate, John Harvard, and Thomas Starr King; 'Dr. Gallaudet and His First Deaf Mute Pupil'; 'Statue of the Republic'; and the Milmore Memorial. He was placed in charge of the sculpture department of the St. Louis exhibition.

French, Henry Willard, American journalist and author: b. Hartford, Conn., 1854. He is known as a war correspondent and lecturer and among his writings may be mentioned: 'Nuna, The Brahmin Girl'; 'Desmonde, M.D.'; 'Art and Artists'; 'Our Boys in China'; 'Our Boys in India'; 'Our Boys in Ireland.'

French, John Denton Pinkstone, English soldier: b. Ripple, Kent, England, 28 Sept. 1852. He served in the navy 1866–7, entered the army 1874 and fought in the Sudan campaign of 1884. In the Boer war in South Africa (1900) he commanded the cavalry division, directed the operations about Colesberg from 10 Nov. 1899 to 31 Jan. 1900, and commanded the cavalry in the movements that led to the relief of Kimberley in February 1900, and the capture of Bloemfontein and Pretoria. His services in South Africa were recognized by his promotion to the command of the First Army Corps at Aldershot, in which he ranks as major-general.

French, L. Virginia (Smith), American poet: b. Maryland 1830; d. McMinnville, Tenn., 31 March 1881. She was associate editor of the 'Southern Lady's Book,' a fashion magazine, published in New Orleans (1852). Her collected works are: 'Wind Whispers,' poems (1856); 'Iztalilxo,' a tragedy (1859); and 'Legends of the South' (1867).

French, Mansfield, American educator: b. Manchester, Vt., 1810; d. 1876. He was educated at Kenyon College, Ohio, and from 1845 to 1848 was president of the Female College, Xenia, Ohio. He was active in the founding of Wilberforce University, the first college for the colored race, as he had been one of the founders of Marietta College. An ardent abolitionist, he laid before President Lincoln his plans for the education of the negroes as preliminary to their emancipation. The National Freedman's Relief Association was the realization of his views, as he had stated them at a mass meeting held in Cooper Union, New York, February 1862.

French, William Henry, American soldier: b. Baltimore, Md., 13 Jan. 1815; d. 20 May 1881. He was graduated from West Point in 1837, served in the Seminole and Mexican wars, was commissioned brigadier-general of volunteers and major of United States artillery, and was mustered out of the volunteer service in 1864 after having for a time commanded the 3d Army Corps. He commanded the 2d Artillery 1865–72, and was retired with rank of colonel in 1880. He commanded the forces which suppressed the Baltimore & Ohio Railroad riots (1887).

French Alliance, The, in American history, an alliance, offensive and defensive, between France and the American colonies, signed in 1778. Three American commissioners, Benjamin Franklin, Silas Deane, and Arthur Lee, sent to the court of France at Versailles, obtained recognition of the independence of the United States, and effected an alliance between the greatest European rival of Great Britain and her revolting colonies in America. The treaty stipulated that should war ensue between France and England it should be made a common cause, that neither France nor America would make peace without the consent of the other, nor should either lay down its arms until the independence of the colonies should be established. The news of the alliance provoked great enthusiasm in the American colonies. See UNITED STATES — AMERICAN REVOLUTION.

French and Indian War. See COLONIAL WARS IN AMERICA.

French Broad River, a river of North Carolina and Tennessee, rising in Henderson County, of the former State, near the foot of the Blue Ridge, flowing northwest into Tennessee, and discharging into Holston River, four miles above Knoxville. It is about 200 miles long. From Asheville to the Tennessee line it is remarkable for its beautiful scenery, flowing through deep mountain gorges, or overhung by high cliffs. In Buncombe County, N. C., are precipices known as the Chimneys and the Painted Rocks. The latter, which are between 200 and 300 feet high, derive their name from some Indian pictures still to be seen on them.

French Chalk, a variety of steatite or talc (q.v.) occurring in fine-granular or scaly masses of milky-white color and pearly lustre. It is extensively used by tailors as a crayon for marking cloth, also as an absorbent in removing grease spots.

French Congo, Africa, a large French territory on the west coast between the Lower Congo and the German Kamerun country, and stretching inland to Lake Chad; total area, about 500,000 square miles. The chief rivers are the Muni, Gabun, Ogowe, and Kuilu, and the stations already founded include Libreville, the capital (pop. 3,000), Brazzaville, Njola, Philippeville, Bonga, Loango, Franceville, and about 20 others. The district is under a commissioner-general, assisted by two lieutenant-governors. Though it is unhealthy even in the more elevated districts for Europeans, considerable trade is carried on, the exports comprising caoutchouc, cocoa, coffee, ivory, ebony, mahogany, palm-oil, gum-copal, etc. Pop. 8,000,000 to 12,000,000, of whom 1,200 are Europeans.

French Creek, N. Y., in the War of 1812. In the course of Wilkinson's invasion of Canada late in 1813 (see CHRYSTLER'S FARM), Gen. Jacob Brown posted himself on the St. Lawrence near the present Clayton, N. Y. On 1 November the British sent two brigs, two schooners, and eight gunboats to dislodge him; but his three-gun battery on a hill at the mouth of French Creek drove them off. They returned the next morning and were again repulsed, with severe loss. The Americans lost two killed, four wounded.

French East India Company. See EAST INDIA COMPANIES.

French Guiana. See GUIANA.

French Guinea, gĭn'ĭ, West Africa, a French colonial possession, between Sierra Leone, Liberia, Senegal, and Portuguese Guinea. The area is about 95,000 square miles and the population (1901) 2,200,000. The centres of population are Konakry, the capital, on the Isle of Tombo, and Boké, Ubrèka, and Timbo. The products are rice, millet, earth-nuts, gum, and rubber. A railroad of 80 miles has been built from Konakry to the Niger. There are 1,060 miles of telegraph line in the colony. In 1900 the imports were $2,755,250, and the exports $1,887,600. The colony is under the administration of a governor, who is under the governor-general of French West Africa. The French colonized the section as early as 1685.

French Indo-China, generally, the French possessions in southeast Asia, which include Cochin-China and the protectorates of Tongking, Laos, Annam, and Cambodia. French Indo-China is bounded by the China Sea, the Gulf of Siam, and the Mekong River. The area and population are given (1901) as follows:

PROTECTORATE	Area Sq. m.	Population
Annam	52,100	6,124,000
Cambodia	37,400	1,103,000
Cochin-China	22,000	2,968,529
Laos	98,000	605,000
Tongking	46,400	7,036,900
	255,900	17,837,429

The military forces of Indo-China consist of 10,901 European troops and 15,000 native soldiers. Over 1,000 miles of railroad were in operation in 1902. Indo-China is under the administration of a governor-general, and lieutenant-governor or resident superiors. The local revenue of the possessions equal the expenditure. See ANNAM; CAMBODIA; COCHIN-CHINA; LAOS; TONGKING.

French Language. See FRANCE.

French Literature. See FRANCE.

French Polishing, a process, generally employed for giving a smooth surface-coating to furniture and cabinet-work. The surface of the wood being finished off with glass-paper and placed opposite the light, the rubber (a ball of wool covered with rag), dipped in the varnish (or polish), is passed quickly and lightly over the surface in the direction of the grain of the wood, and rubbed till dry. This operation must be repeated several times. The most common of the varnishes known under the name of French polish are prepared as follows: Pale shellac, 5½ ounces; finest wood-naphtha, 1 pint; dissolve. Before applying any of these varnishes the rubber must be first slightly moistened with raw linseed oil. See VARNISH.

French Revolution. See FRANCE, *History of.*

French River, Canada, a stream in Ontario. It empties into Lake Huron after a course of 55 miles. For 150 years it was the regular route to the upper lakes.

French Shore. See NEWFOUNDLAND.

French Somaliland, sō-mä'lē-lănd, Africa, a French colonial possession on the west shore of the Gulf of Aden, adjoining Abyssinia. The area is about 46,000 square miles and the population about 200,000. It is administered by a governor and general council. The sea fisheries and interior trade are the only commercial industries. In 1900 the imports were $1,200,000 and the exports $800,000. Among the exports are coffee, ivory, gold, and sheepskins. French and English vessels visit the coast regularly and there are 100 miles of railroad in operation. The principal towns are Jibutil, the capital, Obok, Tagurah, Ambado, Gobad, and Sagallo.

French Spoliation Claims. During the great European wars from 1793 on, French privateers assailed neutral commerce, of which the American was chief, under various pretexts or without any; one was that the United States had violated the treaty of 1778. In the virtual French-American war of 1798–9, their privateers about the West Indies and elsewhere made prize of a great quantity of American shipping, for which our commissioners vainly endeavored to obtain indemnification. Finally, in the treaty of 30 Sept. 1800, as there was no hope of getting the money from Napoleon, the United States for other considerations waived the claim; and in the Louisiana Purchase Treaty of 30 April 1803 a part of the consideration was the assumption by the United States of its citizens' claims against France, then amounting to $3,750,000. Thence till 1885, when the cases were referred to the court of claims, nearly every year saw a bill before Congress to pay these claims, and twice a vote for it was obtained, which was vetoed by the President in each case — Polk and Pierce. The court finally adjudicated several thousand claims, and awarded some $4,800,000.

French Sudan', Africa, the name officially given to a large tract of country in the western Sudan, including the upper basin of the Senegal and the countries watered by the Upper and Middle Niger. It is bounded on the west by Senegal, on the south partly by the French territory of Rivières du Sud, and on the east by independent tribes and by British territory. Officially it is divided into "annexed territories," mostly in the western part, and protectorates. The former have an area of 54,000 square miles and a population of 360,000, while the latter have an extent of 300,000 square miles with a population of about 2,500,000. The control of this region is entrusted to a military commandant subject to the governor of Senegal and residing at Kayes on the Senegal River. A railway has been opened between Kayes and Bafoulabe at the junction of the head-streams of the Senegal.

Frenchman's Bay, Maine, an ocean inlet in Hancock County, extending inland 25 miles with a width of 10 miles. It contains a number of islands, among them Mount Desert, whereon is situated Bar Harbor (q.v.).

Frenchtown, Md., in the War of 1812. As part of the British operations on Chesapeake Bay in 1813, Sir George Cockburn was sent to close its head. Establishing himself first at the mouth of the Susquehanna, then on Elk River, on 28 April he sent 150 marines to destroy the stores at Frenchtown, a small village much used in the land transport between Baltimore and Philadelphia since the closure of the Bay. They drove off the Americans, and burned the stores and five vessels lying near.

Frenchtown, Mich., a township in Monroe County; 22 miles southwest of Detroit. In this vicinity 14 Jan. 1813 an American force of 650 defeated 500 British and Indians. On 20 Jan. the American forces were defeated and taken prisoners. On the 23d the wounded were massacred in what is known as "the massacre of the River Raisin." See WAR OF 1812, THE.

Freneau, Philip, American poet: b. New York 2 Jan. 1752; d. near Freehold, N. J., 18 Dec. 1832. Graduated from Princeton in 1771, he was captured in 1780, during a voyage to the West Indies, by an English cruiser, and his experiences while under detention he later recorded in 'The British Prison-Ship.' Having regained his liberty, he wrote much for the 'Freeman's Journal' of Philadelphia. In 1790 he became editor of the *Daily Advertiser* (New York), and in 1791 of the *National Gazette* (Philadelphia). After an interval at sea he permanently settled in New Jersey. Freneau was the first national poet of America, and a lyrist of real though uneven gifts. His elegy, 'The Battle of Eutaw Springs,' was praised by Scott, who called it "as fine a thing of the kind as there is in the language." During the Revolution he was active in satirical verse. His work attests his extensive culture; and though it conforms in the main to the conventions of the 18th century, it does not lack distinction. He wrote also several volumes of prose, published under the pseudonym "Robert Slender" and of small merit. Until recently his poetry has been strangely neglected; but in 1901 appeared a biography by Austin, and in 1903 an edition of the poems, with a 'Life,' prepared by F. L. Pattee. During Freneau's life there were editions in 1786, 1788, 1809, and 1815. There were reprints of the 1786 edition in 1861 and 1865. Consult further: Tyler, 'Literary History of the American Revolution' (1897); and Wendell, 'Literary History of America' (1900).

Frère, Charles Théodore, shärl tā-ō-dōr frār, French painter: b. Paris 24 June 1815; d. there 25 March 1888. He was a pupil of Cogniet and Roquelan, and made his first exhibit in 1834. He was present at the fall of Constantine, Algeria, in 1837, and from that time chose scenes from eastern life. His pictures illustrating Constantine (1840–8) are among the best he painted.

Frere, frēr, SIR **Henry Bartle Edward,** English statesman and administrator: b. Clydach, Brecknockshire, Wales, 29 March 1815; d. Wimbledon, Surrey, 29 May 1884. He was educated at Haileybury College; entered the East India Company's Civil Service in 1833; introduced improvements into the system of tax collection, and distinguished himself as an administrator. At the outbreak of the Mutiny in 1857 he promptly seized the fortress of Multan, retained command over his own province, and was enabled to assist the neighboring provinces. In 1862 he became governor of Bombay, and in 1867 he was knighted. In 1872, as British commissioner, he negotiated a treaty with the sultan of Zanzibar abolishing the traffic in slaves. In

1877 he was appointed governor of the Cape, and high commissioner in South Africa to settle native and colonial affairs, but the war which he provoked with the Zulus gave so much dissatisfaction to the government that in 1880 he was recalled. See 'Life,' by J. Martineau (1895).

Frere, John Hookham, English poet, translator, and diplomatist: b. London 21 May 1769; d. Malta 7 Jan. 1846. After a career in the diplomatic service, he produced his original 'Prospectus and Specimen of an Intended National Work . . . Relating to King Arthur and His Round Table' (1817), better known as 'The Monks and the Giants'; a literary burlesque, full of charming verse and of excellent character-drawing. It naturalized in English the *ottava rima* afterward used by Byron in 'Beppo' and 'Don Juan.' A version of a large part of Aristophanes succeeded this effort.

Frère, Pierre Edouard, pē-ār ā-doo-är frār, brother of Charles Théodore Frère (q.v.), French painter: b. Paris 10 Jan. 1819; d. Anvers-sur-Oise June 1886. He studied under Paul Delaroche, and chose sentimental genre as his specialty; many of his delineations of home- and child-life are full of true and simple feeling and have been frequently reproduced. In technique he was remarkable as a colorist, and his 'Little Gourmand'; 'Curiosity'; 'Repose'; 'The Little Cook'; 'First Steps'; 'Going to School' have long been favorites in the print-shop windows.

Fresco, in art, a term applied, originally by the Italian artists, to pictures executed in water-colors upon a freshly-plastered wall. Mineral or earthy pigments are employed which resist the chemical action of lime, and in drying the colors become permanent. On the revival of the arts in Europe it became customary to decorate the walls of churches, palaces, cloisters, and convents with fresco paintings. The Romans found plaster paintings on brick walls at Sparta, cut them out, packed them in wooden cases, and transported them to Rome. Fresco painting was first made of real importance by the Italians in the 16th century. It is a very common error in this country with antiquarians and writers in general to term the ancient paintings frequently found on church walls, etc., frescos; but there is scarcely an instance of a genuine fresco among them. They are distemper paintings on plaster, and quite distinct in their style, durability, and mode of manipulation. The art is very ancient and widely spread, frescos of early date being found in India, Egypt, Mexico, etc., as also in Pompeii and other places. The example of Michelangelo and Raphael shows how worthy it is of the greatest artists. The painter cannot seduce the senses by soft tints and tender harmony of colors; he is, therefore, reduced to depend solely on form, character, expression.

The methods employed in painting frescos is described as follows in a treatise upon painting by the monk known as Theophilus, a work certainly written before the close of the 12th century: «When figures or other objects are drawn on a dry wall, the surface should be first sprinkled with water till it is quite moist. While the wall is in this state, the colors are to be applied, all the tints being mixed with lime, and drying as the wall dries, in order that they may adhere.» The method is still in general use in Italy and in Munich, for the production of both exterior and interior decoration. In modern practice lime and fine sand are used for the final coating of plaster, which is allowed to dry thoroughly, and then smoothed by the application of pumice-stone. On the evening before the painter is to begin his work the surface is thoroughly damped with water in which a little lime has been dissolved, and the process is again repeated next morning. The colors are the same as those used in true fresco-painting, which we next describe; but *fresco secco* possesses this advantage over true fresco, that the artist can leave his work at any point, and, having simply redamped the wall, again resume it. The *secco* process is excellently adapted for rough decorative work, and is as durable as true fresco; but it is less suited for delicate and refined artistic productions.

Fresco-painting was accordingly the chosen method by which the greatest Italian masters expressed, upon the walls of cathedral and council-room, their deepest conceptions of religion and polity. Giotto employed it in the Arena Chapel of Padua and the Church of St. Francis at Assisi; Orcagna in the Church of Sta. Maria Novella; Fra Angelico in the Convent of St. Mark; Masaccio in the Brancacci Chapel of the Carmine, Gozzoli in the Riccardi Chapel, at Florence; Perugino in the Sala del Cambio of his native city; Luini in the churches of Milan, Lugano, and Saronno; Pinturicchio in the cathedral library of Siena; Correggio in the Cathedral of Parma; Raphael in the Vatican; and when Michelangelo was directed by Pope Paul III. to paint his 'Last Judgment' in the Sistine Chapel in oils, instead of in fresco as at first agreed on, he protested that oil-painting was an art for women and indolent persons, that fresco was the art for men and painters, and was allowed to have his way. The celebrated 'Last Supper' of Leonardo at Milan is a mural painting in oils, not fresco; and the method used, combined with the fact that the production of the work extended over a period of years, and that the faulty masonry of the wall afforded insufficient protection against damp, accounts for the ruined state in which the subject now exists.

Germany has produced the most distinguished fresco painters in modern times, and Cornelius has established his fame by his grand fresco pictures in the Glyptotheca in Munich. Schnorr is also distinguished in this line, and the Villa Massimi, near Rome, is a fine monument of contemporary German art, as Overbeck, Schnorr, and Feith painted the three rooms in fresco. Fresco painting was long disregarded, when all noble and grand conceptions seemed to have fled from the art; and it is only in recent times that it has been taken up again, chiefly by the Germans. Several works of this kind have been executed in the British Houses of Parliament. See ART; MURAL DECORATION; PAINTING.

Frescos, Boscoreale. See METROPOLITAN MUSEUM OF ART.

Fresh-air Work, a form of benevolence or helpfulness; in this particular the taking of poor children from the tenements and slums of large cities to the country or seashore for recreation. It is said to have originated in 1840, when William A. Muhlenberg of New York sent a large number of poor children and invalids to the country for short vacations. The first general fresh-air societies were organized in

1874, and since then a number of newpapers have inaugurated fresh-air funds. There are now societies in 38 cities and 14 fresh-air organizations in New York. In Europe, Switzerland was the first to take up the movement in 1876. In 1895 there were 73 fresh-air colonies in that country. Nearly all European countries and Argentina in South America have taken up the work. Consult, 'Fresh Air Charity in the United States' (1897).

Fresh-water Insects. Insects are essentially creatures of the air and the land; yet a considerable number pass the whole or the greater part of their lives in rivers, lakes, and ponds. Among insects aquatic in all stages we can distinguish between those which glide or skate over the surface of the water, diving not at all, or only exceptionally, and those which habitually dive and swim through the water after the manner of fishes. The most typical of the surface-dwellers are the bugs of the family Hydrometridæ. See Pond-skaters.

Among the Coleoptera the whirligig beetles (*Gyrinidæ*) frequent the surface of ponds and brooks where they may be seen in small companies, performing a whirling, mazy dance over the surface-film. These insects, when they dive, carry down with them a small air-bubble; enclosed in a film between the tip of the wing-covers to the hinder end of the abdomen. They are not, like the pond-skaters, completely enveloped in air while under water. The beetles of a nearly related family (*Dyticidæ*), well called "diving-beetles," belong to the group of insects which live habitually submerged. Their contours are admirably adapted for motion through the water, but there is no dense hairy covering to ensure the formation of an air-bubble and the breathing is provided for in quite another way. The abdominal spiracles open on the upper surface of the segments, which are completely covered by the wing-cases when the wings are shut. The wing-cases being convex and the upper surface of the abdomen depressed, a considerable amount of air is enclosed, allowing the insect to remain submerged for some time.

Another mode of adaptation to life in the water is shown by the water-scorpions (*Nepidæ*). They are provided with a pair of long-grooved appendages at the tail-end of the body; these can be closely pressed together and form a tube, the tip of which pierces the surface-film and conveys a supply of air to the spiracles. These insects, like the allied "water-boatmen" (*Notonectidæ*), have well-developed wings, and make excursions by night to new watery dwelling-places.

Many insects lead an aquatic life only during their larval stage. Naturally enough, however, such insects when adult are to be found flying chiefly in the neighborhood of water in which they will lay their eggs — the May-flies and midges for example. The contrast between the conditions of the larval and the imaginal life in such cases is most striking, and can only have been brought about by slow degrees. A certain amount of moisture in the earth is necessary to the well-being of many burrowing larvæ, while some are found in semi-liquid mud, in decaying refuse, or in animal excrement. In such surroundings breathing through the lateral spiracles becomes impossible, and we find that access to the air-tubes takes place only by one or two pairs of spiracles near the head or tail-end of the body, sometimes opening through "respiratory trumpets" whose expanded mouths can be thrust out of the clogging surroundings of the mud or refuse into the fresh air, while the grub remains concealed and continues to feed. A similar suppression of most of the spiracles, with the development of a tubular process at the tail end of the body in connection with the tracheal system, is the adaptation by which many aquatic larvæ breathe — for example, the grub of the mosquito. The families of insects nearly related to these have larvæ which live in mud and damp earth, and this suggests that it was from the shores that the waters were invaded by these insect-hosts.

But there is another division of aquatic larvæ still more perfectly adapted to life in the water. The grub of the gnat or the drone-fly needs to rise to the surface at intervals and pierce the film with its air-tube in order to get a fresh supply of oxygen. But the pupa of the sand-midge, with its tubular gill-filaments, or the larva of a May-fly with its tracheal gill-plates, can remain in the water throughout its life, drawing, as do the fishes, sufficient oxygen from the dissolved air. It is interesting to notice that within the limits of a single and restricted order — the dragon-flies — we find some larvæ breathing by means of tracheal gill-plates, and others taking supplies of water into the hind-gut over whose walls run branching air-tubes; while in the final nymph stage the thoracic spiracles are open, and the insect raising the front part of its body above the surface, breathes through them after the manner of an imago. These various adaptations to an aquatic life within a single group indicate clearly that the habit of living in water is not primitive among insects, but that it has become acquired by different races at different times in the course of the development. It may be presumed that larvæ with the more perfect adaptations for breathing when submerged — leaf-like or thread-like gills — are older inhabitants of the water than those which have to rise periodically to the surface to take in a supply of air.

Fresh-water Mussels, bivalved mollusks that dwell in lakes and rivers; river-mussels, or river-clams. They belong to the family *Unionidæ,* allied to the cockles, which has a large and thick foot, no byssus, siphon short (when present), and a parasitic embryonic growth. The shells are equivalve, varying according from thin and smooth to very thick, rugose and knobbed; the hinge variable (in *Anodonta* having no hinge-teeth); and the interior always thickly nacreous, making it useful in the arts as "mother of pearl," and often producing fine pearls. The family is world-wide in its distribution and includes about a dozen genera, two of which (*Unio* and *Anodonta*) occur in most parts of the world. These mollusks dwell in rivers and ponds, and vary greatly according to the character of their home, whereby a great number of supposed species have been named that are now known to be merely varieties of the same stock resulting from different environment. They stand upright in the sand on the blades of the shell, so that the heavy hinge margin receives any blow from drifting stones, or other harm; and slowly move about, sucking

in the minute animal and vegetable organisms upon which they feed. (See PELECYPODA.) The development of their young is most unusual. The eggs when ejected from the ovaries are caught in the gills of the mother and are sustained by a nutritive mucuslike secretion, until they reach a certain degree of age, when they become "glochidia."

They then have a larval shell, provided with strong hooks, and possess a long filament. After a period they are expelled through the exhalent siphon into the water, and this ejection may be timed to the passing of a small fish, to whose body if they touch it the glochidia at once cling by means of the hooks. Should they miss striking against a fish when thrown out the embryos sink and lie upon the bottom with their shells gaping and the filament floating upward. There they remain until a "host" comes within reach; but this must soon happen or they will perish. The glochidia of *Unio* usually become attached to the gills; those of *Anodonta* to the skin or the fins. In this position they become overgrown by the skin or mucous membrane of their host, and are nourished by his juices. This goes on for about 10 weeks, during which time the glochidium has been metamorphosed into a young normal mussel, drops off and begins the ordinary course of life. Their life is probably long.

Mussels abound in all the rivers of the United States and were extremely numerous and varied in those of the Mississippi; and they entered very largely into the fare of the native red men, as is attested by the large refuse-heaps of their shells to be found in all the river courses. It was long ago discovered, however, that these shells yielded pearls of great beauty and price (see PEARL), while the mother-of-pearl of many species was marketable for the manufacture of buttons and similar articles. The result has been a serious depletion of the mussels of many parts of the Middle West, and nearly an extinction of some species.

Fresnel, frā-nĕl, **Augustin Jean,** French physicist: b. Broglie, France, 10 May 1788; d. Ville d'Avray, near Paris, 14 July 1827. He was educated at the Ecole Polytechnique, and early devoted himself to the practice of civil engineering. In 1815 he became distinguished as the discoverer of the polarization of light, and in 1823 was elected a member of the Academy. He made important researches respecting the wave theory of light. The result of his great discovery is shown in the system of lens lighting apparatus, which has changed the mode of lighthouse illumination over the whole world, and is universally known as the "Fresnel system." In 1825 Fresnel was elected F. R. S. of London, and in 1827 received the Rumford medal of the society.

Fresnel's Surface. See LIGHT.

Fresnillo, frĕs-nēl'yō, Mexico, a city in the State of Zacatecas. It has a spacious square, with a costly fountain in the centre, and contains several large churches. In its vicinity are the celebrated mines of Fresnillo, reckoned among the most productive in Mexico. Pop. 13,000.

Fresno, Cal., a city and county-seat of Fresno County, situated on the San Francisco & S. J. V., the Southern P., and Atchison, T. & S. F. R.R.'s. The city is an important fruit-growing centre, the raisin trade alone being valued at $3,000,000 annually. Other important industries are the cultivation and exporting of oranges, grapes, and olives, besides a large livestock trade.

Fresno was settled in 1872, became the county-seat in 1874, and received a charter as a city in 1885. The government is controlled by a mayor, chosen every four years, a municipal council, and other administrative officials. The assessed property valuation is about $6,000,000. Pop. (1900) 12,470.

Freund, froint, **Herman Ernst,** Danish sculptor: b. Uthlede 15 Oct. 1786; d. 30 June 1840. At first a blacksmith, he studied at the Copenhagen Academy of Fine Arts, won the Academy's large gold medal with allowance for foreign study, and resided in Rome, where he was greatly assisted in artistic progress by Thorwaldsen and executed his 'Mercury' and 'Luke.' His conspicuous successes were produced in the domain of Norse mythology, to which field belongs his Ragnarök frieze, done in 1827 for the Christianborg Palace, where it was nearly destroyed by fire in 1884, and later restored by Ginding. Further works by him are 'Eurydice,' 'Thor,' and 'Mimer and Bolder Consulting the Norns.' See Life by Victor Freund (1883).

Frey, frī, **Albert Romer,** American author: b. N. Y. 17 Feb. 1858. He is secretary of the Shakespeare Society of New York and has written in refutation of Ignatius Donnelly's 'cipher' theory of Shakespearian authorship. Among his other writings are 'William Shakespeare and alleged Spanish Prototypes' (1885); 'Soubriquets and Nicknames' (1887).

Frey, Emil, Swiss president: b. Arlesheim, near Basel, 24 Oct. 1838. While in the United States in 1861 he enlisted as a sergeant in the Federal army, was taken captive at Gettysburg and confined in Libby prison. He returned to Switzerland in 1865, there becoming prominent as a journalist, and was minister from Switzerland to the United States 1882–7. He was elected president of the Swiss Confederation 14 Dec. 1893. He is a noted advocate of educational progress and reform and has been prominent in the furtherance of public works and of army improvement.

Frey, Heinrich, German anatomist and zoologist: b. Frankfort-on-the-Main 15 June 1822; d. Zürich 17 Jan. 1890. He began his studies at Bonn in 1840, and continued them up to 1845 at Berlin and Göttingen, when he took the degree of Doctor in medicine and at the last named university became assistant professor of physiology. In 1848 he was appointed professor of histology and comparative anatomy at Zürich. He was considered one of the first microlepidopterologists of Germany. The range of his published works is wide. He wrote a 'Text-Book of Zootomy' (1847); 'An Introduction to the Study of Invertebrates' (1847); several works on histology, a book on the microscope, and an elaborate account of the lepidoptera of Switzerland.

Freyberg, frī'berg, **Konrad,** German painter: b. Stettin 14 May 1842. He studied at the Art Academy of Berlin and entered the studio of Steffecks, applying himself to the delineation of military subjects, especially cavalry

scenes. His canvases are small, but his portraits of the mounted troops are finished and elegant. He has painted in this style many of the principal figures in the Franco-Prussian War. Among his works may be mentioned 'Prince Karl of Prussia with his Staff' (1872); 'Group of Officers of the Guard' (1875); 'Royal Hunt at Letzlingen' (1881); 'Prince Frederick of Hohenzollern at the head of the Second Regiment of Dragoon Guards' (1885).

Freyburg. See FREIBURG.

Freycinet, Charles Louis de Saulces de, shärl loo-ē dė soos dė frā-sē-nā, French statesman: b. Foix (Ariège) 14 Nov. 1828. He was trained as an engineer, and held several important appointments, being associated with Gambetta in the war department in 1871. He was elected to the senate in 1876, and became minister of public works in the following year. He was minister of foreign affairs and president of the council 1879–80, and these posts he held on several subsequent occasions. In 1888 he became minister for war, and continued to hold that office for five years, during two of which (1890–2) he was also premier. In 1893 he had to resign owing to the Panama scandals. As head of the war department he did much to strengthen and develop the French army. He is the author of several important works on engineering and sanitation, and of 'La Guerre en Province pendant le Siège de Paris' (1871). In 1890 he was elected to the French Academy.

Freytag, Gustav, goos'täf frī'täg, German author: b. Kreuzburg, Prussia, 13 July 1816; d. Wiesbaden 30 April 1895. His first dramatic composition was 'The Bridal Tour,' a comedy (1844); it was followed by a little one-act tragedy, 'The Savant' (1844), and by a small volume of poems, 'In Breslau' (1845); after which he produced 'The Valentine' (1846); 'Count Valdemar' (1847), and 'The Journalist' (1853). Among his works outside of the drama may be mentioned his great novel of social life, 'Debit and Credit' (1855; 40th ed. 1893); 'Pictures from the German Past' (1859); 'The Lost MS.' (1864; 23d ed. 1893); 'Die Ahnen' ('Ancestors'), a cycle of six stories portraying the German civilization from the beginning of historic times; and 'Charlemagne' (1894).

Fri'ar, from the French *frère*, Latin *frater*, signifying brother, is a name common to the male members of any religious order. Thus the Capuchins were originally called Friars Hermits Minor, and the Observants Friars Observants. The term, however, is more exclusively applied to those of the mendicant orders: of which the four chief were the Dominicans (Black Friars), Franciscans (Gray), Carmelites (White), and Augustinians.

Friar-bird, a familiar woodland bird of Australia, of moderate size, with brownish-drab plumage, head and neck bare of feathers and a cowl-like neck-ruff. It is an aberrant form of honey-eater (*Meliphagidæ*), some 16 species, all of the Malayan and Australian regions are grouped in the genus *Philemon*, of which the present species is named *P. corniculatus*, in reference to a horny excrescence upon the base of the culmen of the beak. Its loud cries and other peculiarities have given it many local names, such as 'monk,' 'leatherhead,' 'poor soldier,' 'pimlico,' and 'four o'clock.'

Fribourg, or **Freiburg,** Switzerland, a town picturesquely situated on the Saane, which is here crossed by a magnificent suspension bridge, 905 feet long. It is partly surrounded with walls and towers, and among the chief buildings are the Church of St. Nicholas, a handsome Gothic structure, with a spire 240 feet high, and one of the finest organs in Europe; a town-house with a lime-tree near it, which was planted in 1476, on the day of the battle of Morat (Murten), the cantonal university, founded in 1889, and a Jesuit college. A gorge close to the town is crossed by a second suspension bridge, 689 feet in length and 317 feet high. Pop. (1900) 15,794.

Frick, Henry Clay, American manufacturer: b. West Overton, Pa., 19 Dec. 1849. He began commercial life in a small coke business, which grew to be the largest in the country, and is now president of the H. C. Frick Coke Co. He was prominent as instrumental in putting an end to the Homestead Strike (1892) and has been president of the Carnegie Steel Co.

Friction, the resistance which opposes the sliding or slipping of one body relatively to another body with which it is in contact. It is doubtless chiefly due to the minute irregularities that exist upon the surfaces in contact, the motion being opposed by the interlocking of these irregularities. Two kinds of friction may be recognized: (1) "Static friction," between bodies that are relatively at rest, and (2) "Kinetic friction," between bodies that are actually slipping over each other. Static friction is measured by the force that is required to just cause one body to move upon the other, when the two are pressed together by a certain definite pressure; and the ratio of this force to the pressure with which the bodies are held in contact is called the "coefficient of statical friction." Kinetic friction is measured by the force that is required to maintain one of the bodies that are in contact, in a state of uniform motion with respect to the other one; and the ratio of this force to the force with which the bodies are pressed together is called the "coefficient of kinetic friction." The coefficient of static friction between two given substances may be determined by causing a weight composed of one of the substances to rest upon a smooth plane composed of the other substance. If the plane is nearly horizontal, the weight will not slip upon it; but by increasing the angle of inclination, a position will be found for the plane, such that the weight is just on the point of sliding. The angle that the plane then makes with the horizontal is called the "angle of repose" of the pair of substances of which the plane and the weight are composed; and it may be shown by the elementary principles of mechanics that the coefficient of statical friction for these substances is numerically equal to the natural tangent of the angle of repose. Following are a few coefficients of statical friction, as given by Rankine: Wood upon wood, dry, 0.25 to 0.50; leather on metals, dry, 0.56; leather on metals, greasy, 0.23; metals on metals, dry, 0.15 to 0.20. Rennie found somewhat larger values for the coefficient between metals. Thus for statical friction between dry surfaces, he found: Steel on cast iron, 0.33 for ordinary loads; and for similar loads he found 0.22 for brass upon cast iron. Coefficients of kinetic friction are smaller than

the coefficients of statical friction between the same substances, and all friction is greatly diminished by introducing oils or other lubricants between the rubbing surfaces. In kinetic friction between surfaces that are smooth and well lubricated, the results depend far more upon the nature of the lubricant than they do upon the nature of the rubbing surfaces; and they are also greatly dependent upon the method by which the lubricant is applied. When a journal is lubricated by means of a pad placed underneath it, the friction may be more than six times as great as when the same journal is run in a bath of the same oil. Speed also has a great influence upon the amount of friction developed. Morin's "laws of friction," given in 1831, are as follows: (1) The coefficient of kinetic friction is independent of the pressure with which the rubbing surfaces are pressed together; (2) the coefficient of friction, and the total friction, are independent of the areas in contact, so long as the total pressure between the two rubbing bodies is constant; and (3) the coefficient of friction is independent of the velocity, although static friction is greater than kinetic friction. These laws, which are often given in text-books and elsewhere as reliable presentations of the known facts, are now known to be exceedingly imperfect. Morin gave them for ordinary conditions of shafting and journals, where no special care has been taken with the journals, and no artificial means have been provided for the free supply of oil. It is now certain that they cannot be assumed to apply under other conditions, and it has been pointed out that "there are many conditions under which they lead to the wildest kind of error." The phenomena of friction are in reality quite complicated, and a thorough study of the subject is necessary before the friction that may be expected in any given case can be calculated with even a rough degree of approximation. Consult: Thurston, 'Friction and Lost Work'; Kent, 'Mechanical Engineer's Pocket-Book.'

"Rolling friction," so called, is not true friction, in the sense in which the word has here been defined. It is due mainly to the fact that a wheel when rolling upon a smooth track or other surface, creates a slight depression by its weight, and is also slightly deformed itself at the same time. The energy which is absorbed in producing these slight deformations is in considerable measure dissipated as heat; but the retardation of the moving body from this cause is seldom comparable with that due to sliding friction. For the internal friction of fluids, see VISCOSITY.

Friday, the sixth day of the week, so named from the Anglo-Saxon *Frigedag*, the day of Friga, the wife of Odin and the Teutonic goddess of love. The Anglo-Saxon is a translation of the Lat. *Veneris dies*, day of Venus, whence the French *Vendredi*, Friday. Its religious associations are varied. According to the Mohammedans it was the day when Adam was created, entered Paradise, was expelled therefrom, the day of his repentance, of his death, and is to be the day of resurrection. It is the Moslem "day of assembly" or sabbath. As the day of Christ's crucifixion it is generally observed in the Greek, Latin, and other Christian episcopal churches as a fast day, and is especially observed on Good Friday (q.v.). From the same cause, also, it is regarded among the superstitious as an unlucky day, and was long associated in the public mind with the execution of criminals sentenced to death, which usually took place on Friday and was commonly called hangman's day.

Friedel, frē'dĕl, **Charles,** French chemist: b. Strasburg 1832; d. 1899. He studied under Pasteur in his native town and continued his scientific education at Paris, entering the laboratory of Wurtz. In 1869 he was graduated with two remarkable theses and in 1876 became professor of mineralogy in the Sorbonne. He eventually succeeded Wurtz (1884) as professor of organic chemistry and director of the research laboratory in the Sorbonne, a position he maintained till his death. His researches are record by him in 254 original memoirs and entitle him to a place among the foremost scientific men of the 19th century. His name is especially connected in association with James Mason Crafts (q.v.) with the synthetic method known as the 'Friedel and Crafts reaction' (q.v.). He published, in addition to text-books on mineralogy and crystallography, 'Cours de Chimie Organique Professé a la Faculté des Sciences de Paris' (1887).

Friedel and Craft's Reaction, in chemistry, a synthetic method discovered by the French chemist, Charles Friedel, in conjunction with James Mason Craft. This discovery revealed the action of various chlorinated compounds on hydrocarbons in the presence of aluminum chloride. A vast number of varying organic compounds may thus be produced in any ordinary quantity, for example, triphenyl methane is a commercial compound, necessary to the production of valuable dyes; by Friedel and Craft's Reaction process it can be produced rapidly and cheaply in any quantity required.

Fried'elite, an acid silicate of manganese, containing some chlorine, and crystallizing in the rhombohedral system, but also occurring massive. It is rose-red in color, and is found in a manganese mine at Aderville, France.

Friedericia, frē-dā-rē'sē-ä, **Julius Albert,** Danish historian: b. Copenhagen 1849. He became assistant librarian of the library of the University of Copenhagen in 1891. He has published 'Danmarks ydre politiske Historie i Tiden fra Freden i Lybek til Freden i Brömsebro' (1876–81); 'Adelsvoeldens sidste Dage Danmarks Historie fra Christians IV.'s Dod til Enevoeldens Indforelse' (1894).

Friedland, frēd'länt, **Valentin,** surnamed Trotzendorf, German educator: b. Trotzendorf, Upper Lusatia, Germany, 14 Feb. 1490; d. Liegnitz, 26 April 1556. He became a teacher at Görlitz in 1515. He was for many years at the head of the gymnasium in Goldberg where the students, at times over 1,000 in number, were organized like a Roman republic, with senate, consuls, censors, and the like, with Friedland as perpetual dictator. See Pinzger, 'Valentin Friedland, gennant Trotzendorf' (1825); Lösche, 'Valentin Trotzendorf' (1856).

Friedland, Prussia, a small town 28 miles southeast of Königsberg, on the river Alle. The Russians under Benningsen were here defeated on 14 June 1807 by the French under Napoleon (q.v.) Pop. (1900) 2,824.

Friedländer, Friedrich, frēd'rĭh frēd'lĕn-dėr, Austrian painter: b. Kohljanowitz, Bohemia, 10 Jan. 1825; d. 1901. Among his works, which are confined to historical or genre themes are 'The Death of Tasso' (1852); 'The War Veterans' (1875); 'News' (1883); 'Distribution of Wine' (1884).

Friedländer, Ludwig, lood'vĭg, German classical scholar: b. Königsberg, Prussia, 24 July 1824. His most representative work is 'Typical Studies in the History of Roman Manners and Morals' (6th ed. 1889), written in popular style. 'The Remains of Nicanor's Emendations of the Punctuation of the Iliad' (1850), and like theses, constitute him an authority in Homeric criticism.

Friedman, frēd'man, **Isaac Kahn,** American journalist and novelist: b. Chicago, Ill., 3 Nov. 1870. He was graduated from the University of Michigan in 1893 and has since been engaged in newspaper work in Chicago. He has published 'The Lucky Number,' a collection of short stories of the Chicago slums (1896); 'Poor People,' a novel (1900).

Friedmann, frēd'män, **Alfred,** German poet and novelist: b. Frankfort-on-the-Main, Prussia, 26 Oct. 1845. Among his poems are: 'Merlin,' 'Orpheus' (1874), two ballads; 'Biblical Stars' (1875), comprising three idylls; 'Love's Fire Test, Angioletta'; 'Lays of the Heart' (1888). He is the author of many novels, including: 'Two Marriages'; 'Suddenly Rich' (1891); 'The Wild Rose' (1893).

Friedrich, Johannes, frēd'rĭh yō-hän'nĕs, German Old Catholic theologian: b. Poxdorf, Bavaria, 5 May 1836. After studying at the universities of Bamberg and Munich he entered the Roman Catholic priesthood in 1859. In 1865 he became professor of theology in the University of Munich. At the Vatican Council, 1869–70, he united with his colleague Döllinger (q.v.) in opposing the dogma of papal infallibility, and when acceptance of the dogma was demanded by the archbishop of Munich of the faculty of the Munich University, he with Döllinger declined and was excommunicated. In 1882, however, he was given another professorship, and in 1882 was transferred to the philosophical faculty. He was one of the leaders in founding the Old Catholic Church, but withdrew from active leadership in 1878 when the Old Catholic Synod voted to allow its priests to marry. Among his many writings are 'Tagebuch während des vaticanischen Concils' (1871); 'Zur Verteidigung meines Tagebuchs' (1872); 'Geschichte des Vaticanischen Concils' (1877–87), and 'Life of Döllinger' (1899–1901).

Friedrich, John, American violin-maker: b. Cassel, Germany, 1858. Having studied violin making under Oswald Möckel, he came to the United States in 1883, and shortly took prominent rank in his calling. In 1893 he obtained the highest award for violins, violas, and violoncellos at the World's Columbian Exposition. He has also made bows of very excellent workmanship, and came to be recognized as an expert in identifying and appraising rare specimens.

Friedrich, Kaspar David, German painter: b. Greifswald 5 Sept. 1774; d. Dresden 7 May 1840. He obtained his training in the Copenhagen Academy of Fine Arts, and in 1795 settled at Dresden, where he became member and professor of the Academy. He excelled in depicting nature as seen through the psychologic medium of transitory human moods. Favorite motifs are the gloom of the forest, night scenes with moonlight, or storms at sea. The Castle of Berlin contains two fine examples: 'Abbey in an Oak Forest on a Winter's Evening,' and 'Pilgrim on the Shore.'

Friedrich, Woldemar, vŏl'dė-mär, German painter: b. Gnadau, Saxony, 20 Aug. 1846. He accompanied the German troops in the Franco-German War, and thence gained material for his illustrations in Daheim and in Hiltl's 'Der französische Krieg von 1870–71' (6th ed. 1891). In 1881 he became professor in the art school at Weimar and in 1885 in the Berlin Academy. He executed decorative paintings in Castle Hummelshain, Weimar; the Weimar gymnasium; and the booksellers' exchange at Leipsic. He also painted a series of aquarelles and numerous genre-works in oils.

Friedrichs, frēd'rĭhs, **Hermann,** German author: b. St. Goar, on the Rhine, Germany, 14 June 1854. He distinguished himself in periodical journalism, and also wrote: 'The Revenge of the Bayadere' (1880), a lyric; 'Love Ordeals' (1888), a volume of stories; and 'Forms and Passions' (1889), a book of poems.

Friendly Islands. See TONGA.

Friendly Societies in America. See FRATERNAL SOCIETIES IN AMERICA.

Friendly Sons of Saint Patrick, Philadelphia, Pa., organized in 1790 as the Hibernian Society. The first president was Hon. Thomas McKean, a signer of the Declaration of Independence. Among other prominent members of the society have been Gen. Walter Stewart, Commodore John Barry, Gen. Edward Hand, Col. Francis Nichols, Col. Thomas Proctor, Hon. Thomas Fitz Simons, and Gen. Andrew Jackson. The organization still exists, has a membership of over 600, and has in its treasury $75,000 or $80,000. In December 1897 the name Hibernian Society was dropped and that of the Friendly Sons of Saint Patrick adopted. The latter name had been borne by a Philadelphia society which was organized in 1771 and went out of existence sometime after 1805.

Friendly Sons of Saint Patrick, Society of the, New York city: founded in 1784. To-day, as at all times during its long existence, it numbers in its membership a great many of the most eminent merchants and professional men of New York. Among its presidents have been Hon. Richard O'Gorman, Chief Justice Charles P. Daly, Hon. James T. Brady, Eugene Kelly, Hon. Hugh J. Hastings, Joseph J. O'Donohue, David McClure, Samuel Sloan, John D. Crimmins, Hon. Morgan J. O'Brien, Hon. James A. O'Gorman, and Hon. James Fitzgerald. There are no creed or political tests for membership in the organization.

Friends, The Religious Society of. The Religious Society of Friends, commonly called Quakers, had its origin in England about the middle of the 17th century, and was largely the result of the ministry of George Fox, who is often called its founder.

Early History.— George Fox, the son of a weaver, was born at Drayton, in Leicestershire, 1624, and began his public preaching about the year 1648. His spiritual views and practical application of Christian doctrines met a ready

response in many pious persons (both Churchmen and Dissenters), and bitter opposition from others whose practices they condemned. His followers increased rapidly, and were known as "Children of Light," "Children of Truth," and "Friends of Truth"; finally adopting the name "Religious Society of Friends." Among them were many itinerant preachers; Fox in his journal (1654) says, above 60 in number. From the first imprisonment of Fox in 1649 to 1687 Friends were the objects of almost continuous persecution. In 1656 Fox computed there were seldom less than 1,000 in prison. Between the years 1661 and 1697, over 13,000 Friends were imprisoned in England, 198 were transported as slaves, and 338 died in prison or of wounds received in assaults while attending meetings. These persecutions were upon various pretexts, as, the refusal to pay tithes, to swear, or to remove the hat; for preaching in public places; as disturbers of public worship, for speaking in "churches" (a practice then not uncommon); and as Sabbath breakers, for traveling to their meetings on the day called the Sabbath. Many were apprehended for keeping an unlawful assembly under the Conventicle Act. Scotland, Ireland, the Continent, and America were early visited by their ministers.

The first to arrive in New England were two women, Ann Austin and Mary Fisher, who came to Massachusetts from Barbadoes in 1656. After five weeks' imprisonment and much cruel treatment they were sent back. Stringent laws were promptly enacted by that colony to prevent others from coming and owners of vessels from bringing them. Regardless of the cruel penalties of these laws, the Quakers continued to arrive and suffer their infliction. In numerous instances delicate women were "stripped naked from the middle up, tied to a cart's tail and whipped through the town" and thence through other towns. Four — one a woman — were hanged on Boston Common. Nevertheless they increased in numbers and spread to adjoining colonies.

The first Friends in New Jersey settled along the Raritan River in 1663. In 1677 over 200 came to this province and founded Burlington. William Penn joined the society in 1667. In 1681 he and several other Friends purchased East New Jersey, and in the same year Penn obtained from the crown the grant of Pennsylvania. A few Friends were in the province before Penn acquired it, and two shiploads came in the fall of 1681. The next year Penn himself came with others, and in less than three years the colony had a population of 7,000. For a period of 70 years, and so long as the influence of Friends predominated, there were no conflicts with the Indians. At an early date the society cleared itself of human slavery. Friends began to protest against it as early as 1688, and for nearly 100 years the agitation was continued, until "in the year 1787 there was not a slave in the possession of an acknowledged Quaker." This was largely due to the labors of John Woolman, a minister in New Jersey, whose journal has a literary reputation.

Organization and Discipline.— Fox and his co-laborers did not have an outward organization as an object. The organization and discipline were progressively developed. The first disciplinary meetings established were held monthly and were in a sense congregational. Some were held as early as 1656, but the practice does not appear to have become general before 1666. The first yearly meeting appears to have been held in 1656, the first in London in 1668, but it was not held there regularly until 1672. The first yearly meeting in America was held in Rhode Island in 1661. Monthly, quarterly and yearly meetings have geographical boundaries; and monthly meetings are subordinate to quarterly, and these to the yearly meeting, which is the source of discipline, and final judge of all questions. At stated periods monthly meetings appoint a few of their number as "Overseers," whose duty it is to have a loving oversight of the members. Men and women hold separate meetings for business, although some subjects are jointly considered. Of late years the practice of separate meetings has largely been discontinued. Elders are men and women chosen out of the body as "Friends of solid judgment, prudence, and experience," to sit with the ministers and to advise, encourage or caution them as seems needful. Persons — men or women — who speak and pray in public to the satisfaction of the members are, in due time, publicly acknowledged as ministers, or those in whom the body recognizes the "true gift." Such recognition does not confer upon them any new powers or authority. All members are embraced in a set of "Queries" which are answered, some quarterly — others annually, by meetings for discipline. These have reference to love and unity; attendance upon meetings; consistency in speech, behavior, and apparel; oaths, military service and fraudulent business; moderation in trade and living, and just payment of debts; encouragement of a stated or paid ministry; care of the poor and education of children; and keeping records of births, deaths and marriages. (The answering of "Queries" has been discontinued in many meetings.) Meetings have no presiding officer. In those for business a clerk is appointed, whose duty is to gather and record the sense or judgment of the meeting as expressed. No question is settled by a majority and no vote is taken. Christ is recognized as "the head over all things to the church."

Distinguishing Views.— In the essential doctrines of the Christian religion Friends were in accord with their fellow Christians. The principal points in which they differed were:

1. Immediate Divine Revelation. Barclay ('Apology') says: "Nothing is less minded and more rejected by all sorts of Christians than immediate divine revelation; insomuch that once to lay claim to it is matter of reproach." Again, "He that affirms himself so led (by the spirit of God) is, by the pretended orthodox of this age, presently proclaimed an heretic." Fox (Journal) says: "I saw that Christ had died for all men, and had enlightened all men and women with his divine and saving light. I was commanded to turn people to that inward light, spirit and grace, by which all might know their salvation and their way to God." Friends believed that this inward saving light of Christ was universal and came to both heathen and Christian.

2. Worship and Ministry. Barclay ('Apology') says: "All true and acceptable worship to God is offered in the inward and immediate moving and drawing of his own spirit. All other worship, praises, prayers, and preachings, which man sets about in his own

will, at his own appointment, and can begin and end at his pleasure are but superstitious will-worship." Again, "As our worship consisteth not in words, so neither in silence as silence; but in an holy dependence of the mind upon God: from which dependence silence necessarily follows in the first place, until words can be brought forth which are from God's spirit." Hence silence is the basis of meetings for worship, which can be, and often are, held without a minister or any vocal service. Neither ministers, nor others, are supposed to break this silence without an immediate opening of a subject, and a sense that the Lord requires the delivery of the message revealed. No special training or educational qualifications are considered necessary for the ministry, and no consistent "Quaker" minister accepts pecuniary compensation for services in that capacity. Accepting literally the command of Christ to his apostles, "Freely ye have received, freely give," Friends refuse to pay tithes or in other ways to contribute to the support of a paid ministry.

3. Sacraments. Sacraments require the services of a priest or minister. Friends denied this necessity, rejecting all types and outward ordinances. They taught that the only saving baptism was that of the Holy Spirit, and that the true communion was not partaking of bread and wine, but the spiritual "eating of the flesh and drinking of the blood" of Christ. They held that marriage was the Lord's joining of man and woman, and therefore was not performed by man — men were but witnesses.

4. War, Oaths, etc. Friends have always maintained that war and oaths were inconsistent with Christianity, being forbidden by Christ and his apostles in the New Testament. Consistent members refuse to perform military service or partake in war-like preparations. They refuse oaths in civil courts or elsewhere as forbidden by Christ's language, "Swear not at all." In their early history they suffered much on this account. They decline the use of complimentary titles and language, believing they proceed from pride and tend to foster it. They refuse the complimentary use of the plural pronoun to a single person, although the "thou" and "thee" to judges and magistrates has often resulted in suffering. They use the numerical language of Scripture instead of the names of months and days in honor of heathen deities. Their plainness of dress is a testimony against pride, and any uniformity the result of a refusal to change its style at the dictates of fashion.

Present Condition and Membership.— With some unimportant exceptions the society maintained a practical unity until the year 1827. At that time a separation occurred in Philadelphia Yearly Meeting and later in others. Since then two distinct bodies have claimed the title "Religious Society of Friends," commonly distinguished by the names "Hicksite" and "Orthodox," although not recognized or officially used by either body. The name "Hicksite" came from Elias Hicks, a talented and popular minister of Long Island, whose ministry was the immediate cause of the schism. The Orthodox party hold that unsound doctrines caused the separations. The followers of Hicks, admitting differences in doctrines, contend that the real cause was not so much these differences, as an arbitrary exercise of authority by the Orthodox party. Quotations from Hicks establish the contention that the divinity of Jesus Christ, the doctrine of atonement, and the inspiration and authority of the Bible were denied or questioned. There were probably some grounds for the charge of an arbitrary spirit on the part of the Orthodox. In the separations, two thirds of Philadelphia and New York Yearly Meetings were of the "Hicksite" party, and in Baltimore four fifths; in Ohio they were about evenly divided, while in Indiana Hicks had comparatively few sympathizers. No separations occurred in New England or North Carolina meetings, they continuing to be identified with the Orthodox bodies, which were officially recognized by London Yearly Meeting.

There are (1903) seven yearly meetings of "Hicksite" Friends: Philadelphia, Baltimore, New York, Genesee (Canada), Ohio, Indiana, and Illinois, numbering about 21,000 members. They are connected by epistolary correspondence. Their principal schools are Swarthmore College, and the George School in Pennsylvania, Friends Central in Philadelphia, and similar schools in New York and Baltimore. 'The Friends Intelligencer,' an ably conducted weekly paper, is published in Philadelphia.

Several of the Orthodox yearly meetings have experienced separations. Joseph John Gurney of England, a wealthy and educated minister and voluminous writer, expressed views which many in England and America regarded as subversive of some always held by the society. Prominent among those in America who opposed his views was John Wilbur, a minister in New England. This resulted in a division in that Yearly Meeting in 1845, which was followed by one in Ohio in 1854. These, and later separations in others, resulted in two distinct bodies of Orthodox Friends within the limits of six yearly meetings, including Canada. They have been distinguished by the respective names, "Gurney" and "Wilbur," and the terms "Progressive" and "Conservative." In Ohio the "Conservative" body was the larger, and in each of the others the smaller. London gave its official recognition to the "Progressive" bodies. There are now 13 of these, connected with each other and with London and Dublin Yearly Meetings by correspondence: New England, New York, Canada, Baltimore, North Carolina, Ohio, Wilmington (Ohio), Western, Indiana, Iowa, Kansas, Oregon, and California. Total membership in America about 88,500.

The six "Conservative" yearly meetings are: New England, Ohio, Canada, Western (Ind.), Iowa, and Kansas. These annually exchange epistles. Their membership is about 4,500.

Philadelphia occupies a unique position, not being connected with either of these groups of related yearly meetings. That its sympathies were with Wilbur against the views of Gurney was shown by the recognition of the "Wilbur" Friends in Ohio. Later, in the interest of peace, Philadelphia ceased correspondence with all yearly meetings, and has never regularly resumed it. The membership is about 4,500. Within most "Progressive" yearly meetings paid pastors, prescribed services, singing, instrumental music and revival methods have been introduced; until, in many localities, the so-called "Friends Churches" more nearly resemble "Methodists" than "Quakers." These yearly meetings have organized "The Five Years Meeting," held periodically as the name indicates, having advisory rather than legislative powers.

Most of them have recently adopted a «Uniform Discipline.» The principal schools of Orthodox Friends in America are: Haverford College, Pennsylvania; Earlham College, Iowa; Guilford College, North Carolina; Pacific College, Oregon; Westtown Boarding School, Pennsylvania; Friends Select School, Philadelphia; Friends Boarding School, Providence, R. I.; Friends Boarding School, Barnesville, Ohio. Their principal periodicals are: 'The Friend,' Philadelphia (weekly), in its 77th year of continuous publication of uniform size and style; 'The American Friend,' Philadelphia (weekly), organ of the Progressive Yearly Meetings.

STATISTICS.

London Yearly Meeting	17,476	
Dublin Yearly Meeting	2,528	
Australasia	550	
Continental: Norway, Denmark, Germany, France, Turkey	247	
Total abroad	20,801	
In America:		
Hicksite Friends	20,773	
Progressive Friends	88,401	
Conservative Friends, about	4,500	
Philadelphia Yearly Meeting, about	4,500	
Primitive Friends, about	225	
Total in America		118,399
Total in foreign countries		20,801
Total in the world		139,200

Bibliography.— Barclay, 'Apology' (1678); Evans, 'Exposition of Faith' (1827); 'Friends' Library' (14 vols. 1837–50); Fox, 'Journal' (1694); Gurney, 'Observations on Distinguishing Views and Practices' (1824); Hodgson, 'Society of — in 19th Century' (1876); Janney, 'History of' (1859); 'Life of Thomas Ellwood' (1714); 'Passages from Life and Writings of William Penn'; Sewel, 'History of Rise' (1722); Sharpless, 'Quaker Experiment in Government' (1898); Smith, 'Catalogue of Friends Books' (1867); Thomas, 'History of, in America' (1895); Wilbur, 'Journal' (1859); Woolman, 'Journal.'

EDWIN P. SELLEW,
Publisher of 'The Friend,' Philadelphia.

Fries, frēs, **Elias Magnus,** Swedish botanist: b. Smaland, Sweden, 15 Aug. 1794; d. Upsala 8 Feb. 1878. In 1834 he was called to the chair of practical economics at Upsala, with which in 1851 that of botany was conjoined. Fries introduced into Sweden the morphological theory in his 'Systems of the Vegetable World' (1825). His work on 'Mycology' (1820–32) was long the standard work on the classification of fungi, of which he gave a relatively complete catalogue in 'Scandinavian Flora' (1846–9). He wrote a series of useful books on the *Hymenomycetæ,* on lichens, and on the flora of Scandinavia, more particularly of Sweden. Among his monographs is one on the 'Hieracieæ' (1848). In 1851 Fries was appointed director of the botanical museum and garden at Upsala, and in 1853 rector of the university.

Fries, Jakob Friedrich, yä'kōb frēd'rĭн, German philosopher: b. Barby, Prussia, 23 Aug. 1773; d. Wartburg, Germany, 10 Aug. 1843. He is a link between Kant's system and the so-called historical school. 'The New or Anthropological Critique of Reason' (1807) is his most important book. He wrote 'Handbook to Psychical Anthropology' (1820); 'System of Metaphysics' (1824), etc.

Fries, John, American insurgent: b. 1764; d. 1825. When in July 1798, Congress voted a direct tax of $2,000,000 the federal officers who were sent to Pennsylvania to collect the State quota of $237,000, were resisted by a party of opposition which Fries had rallied from among the Germans of Montgomery, Lehigh, Bucks and Berks counties. At Bethlehem, 7 March 1799, the United States marshal was compelled by this party to release 30 prisoners who had been arrested for refusing to obey the law. The «rebellion» was at length put down by the militia which President Adams ordered out, and among those captured was Fries, who was subsequently twice tried and on each occasion sentenced to death. In April 1800 he was pardoned by President Adams, who at the same time proclaimed an amnesty to all concerned in the «rebellion.»

Friese, frē'zė, **Richard,** German painter: b. Gumbinnen, East Prussia, 15 Dec. 1854. He studied at Berlin, and traveled in the East, as well as northward within the Arctic Circle. He is now considered one of the best of German animal painters, and is equally successful in depicting the lion in the desert and the deer in a German forest. In 1886 he was awarded a gold medal by the Berlin Academy, of which body he was elected a member in 1892. His most famous works are: 'Lions Surprising a Sleeping Caravan' (1884), in the Dresden Gallery; 'On the Bredszell Moor' (1895), in the Königsberg Museum.

Friesland, frēz'lănd, or **Vriesland,** frēs'länt, a province in the Netherlands, bounded partly by the German Ocean and the Zuyder Zee. It is generally flat, and parts of it are below sea-level, being protected by dykes. Excellent horses, the best in Holland, cattle, and sheep are reared, and cattle and other agricultural produce are sent to England. It is sometimes called West Friesland, to distinguish it from East Friesland, now the district of Aurich in Hanover. It is divided into three districts — Leeuwarden, containing the capital of same name, Sneek, and Heerenveen. Area, 1,281 square miles. Pop. (1901) 345,004. See NETHERLANDS.

Frieze, Henry Simmons, American educator: b. Boston 15 Sept. 1817; d. Ann Arbor, Mich., 7 Dec. 1889. He was graduated from Brown University in 1841, was instructor there from 1841–5, and in the grammar-school connected with the university 1845–54, and from 1854 professor of the Latin language and literature in the University of Michigan, of which in 1869–71 and 1880–1 he was the acting president. He did much to promote the interests of the university, obtaining for it a State appropriation of $75,000 and an important library in political science. He published: an edition (1860) of the 'Æneid,' and (1867) of the 'Ars Rhetorica'; and 'The Story of Giovanni Dupré' (1886).

Frieze, (1) the architectural term for that part of an entablature between architrave and cornice or any similar position, in a work of structural decoration. It is often enriched with figures of animals, etc., in relief, and is sometimes divided into triglyphs and metopes. One of the best known examples is the Panathenaic, frieze around the cella of the Parthenon. (See ARCHITECTURE.) (2) The name of a thick woolen stuff or cloth with a nap on one side, in use since the 14th century for heavy outer garments. Frieze is largely made in Ireland, whence considerable quantities are exported.

Frigate, the designation in the days of wooden war vessels of a full-rigged ship with two decks, and so distinguished from a ship of the line which had three. Frigates were usually fast sailers, mounted with 28 to 60 guns, and were employed as scouts and as cruisers, to convoy merchantmen, etc. With the introduction of armor-clad war vessels the term frigate has been superseded by that of cruiser, but a large full-rigged merchantman is still sometimes so called. The name originally was used in the Mediterranean to designate a long, swift vessel propelled by oars and sails.

Frigate-bird, or **Frigate Pelican.** See MAN-OF-WAR HAWK.

Frill-lizard, a large Australian lizard (*Chlamydosaurus kingi*) of the family Agamidæ, so called in allusion to the erectile collar or ruff about its neck. This broad membrane is supported on each side of the neck by slender rods from the hyoid bone which extend to its margin like the sticks of a fan; and like a fan it may be folded close against the shoulders or spread until it stands up all around the back part of the head; but this erection can be accomplished only by opening the mouth widely, and always accompanies a stretching apart of the jaws. The exterior of the frill is of the general grayish-brown of the animal's body, but its interior or front is scarlet; and when it is suddenly spread in the face of an enemy behind the open hissing mouth, it is calculated to astonish and frighten the attacker in no small degree, as seems to be the purpose of the structure. These lizards are 6 to 8 inches long plus a long, lash-like tail. They spend their time on trees and logs, searching for the beetles which constitute their principal food; and have an extraordinary manner, when in haste, of rising and running upon their hind legs alone. The species has been extensively described and illustrated by Saville Kent in his books on the natural history of tropical Australia.

Fringe-tree (*Chionanthus virginica*), a beautiful tree of 10 or 20 feet in height, with somewhat oval, smooth, entire leaves, white narrow-petaled flowers in drooping racemes, and oval, purple drupes. Its blossoms are not only suggestive of its English name, but of the generic title of *Chionanthus*, "blossoms of the snow." It is found in the United States from latitude 39° to the Gulf of Mexico, and forms an attractive feature in garden shrubbery. In the southern States it is known as old-man's-beard.

Fringed Dragon, one of the names of the Australian lizards of the genus *Chlamydosaurus*, characterized by an erectile neck-ruff. See FRILL-LIZARD.

Fringillidæ, frĭn-jĭl'ĭ-dē, the finch and sparrow family, an extensive group of oscine birds, regarded as the most highly organized of all birds. The old name *Fringilla*, applied by Linnæus to the whole group, is retained only for the typical genus, represented by the chaffinch (q.v.). All the fringillines are small, compact and active, without eccentricity of form or plumage, and with organs adapted to an omnivorous diet, although seeds form the principal part of the fare. The bill is usually stout and cone-shaped, varying from a greatly swollen size in some of the grosbeaks to the slenderness of that of the goldfinch. The legs are short, and scutellate; the feet strong; and the wings and tail do not vary much from normal, but the wing has a minute outer primary. The plumage is varied, and in many genera the sexes are unlike. These birds mainly frequent fields, roadsides, and woodlands; and build their nests (often elaborate structures) in trees, in bushes or on the ground — never in burrows, or tree-holes, or composed of mud. Their eggs are usually five in number, and usually are spotted. The family includes extremely good singers, and furnishes us not only the canary but many other of the most popular cage-birds; also many whose flesh is considered a delicacy. The group is divided into scores of genera and contains hundreds of species, which predominate in the northern latitudes of the Old World, where many are resident throughout the year; but they also abound in all other parts of the world except Australia. See Evans 'Birds' (1900), and for America the exhaustive monograph by Ridgway in his 'Birds of North and Middle America,' Part I. (1901). See BUNTING, FINCH, GROSBEAK, LINNET, REDPOLL, SPARROW, and names of various species.

Frisian, or **Friesian**, the term applied to a native and to the language of Friesland. The Frisians are descended from a German tribe, who, at the beginning of the Christian era, occupied the territory between the mouths of the Rhine and the Ems, in the modern provinces of Groningen and Friesland. They became tributaries of Rome under Drusus, and lived for some time on friendly terms with their conquerors, but were driven to hostilities by oppression. They were partially subdued in 47 A.D., and rebelled again with the Batavians under Civilis. In the 5th century a host of Frisians joined the Angles and Saxons in invading Britain. About the end of the 7th century the Frisians in the southwest were subdued by the Franks under Pépin d'Héristal, who compelled them to accept Christianity. A century later the eastern branch of the tribe was conquered and Christianized by Charlemagne. Their country was divided into three districts, two of which were annexed on the division of the Carlovingian Empire to the possessions of Louis the German, and the other to those of Charles the Bald. The latter part was called West Frisia (West Friesland), and the two former East Friesia (East Friesland). The distinctive national features were gradually lost by assimilation with their neighbors, and their modern history is chiefly connected with Holland and Hanover.

The *Frisian Language*, a Low German dialect, holds in some respects an intermediate position between Anglo-Saxon and Old Norse. Of all the Teutonic dialects it is the most nearly related to English. Its ancient form exists in some remarkable collections of laws, of which each Gau or district had its own set written in its own language. The Asegabuch (dating from 1200) was a series of laws valid for all Friesland. An almost complete collection of those laws is to be found in Richthofen's 'Friesische Rechtsquellen' (1840). The modern Frisian is mostly confined to the peasantry. It is broken up into three dialects; the North Frisian on the west coast of Schleswig, its islands, and Helgoland; the Batavian comprising the common West Frisian, and those of Mulkweren and of Hindelopen; and the Westphalian, whose vari-

etics are the East Frisian and those of Rustringen, Wursten, and Saterland, each of which is more or less unintelligible beyond the narrow district in which it is spoken. Among specimens of Frisian literature are, 'Waatze Gribberts Brilloft,' a comedy (1712); 'It Libben fen Aagtje Ysbrants,' a novel (1779); the writings of Japicx, Althuysen, the brothers Halbertsma, Dijkstra, Troelstra, and others. Consult: Grimm's 'Deutsche Grammatik'; the 'Altfries'; 'Wörterbuch' of Richthofen; Doornkaat Koolman's 'Wörterbuch der Ostfriesischen Sprache'; Van Helten's 'Altostfriesische Grammatik'; Hewett's 'Frisian Language and Literature.'

Frit. See FRITTING FURNACE; GLASS.

Frith, William Powell, English painter: b. Studley, near Ripon, 9 Jan. 1819. Since 1840, when he exhibited 'Malvolio before Olivia' at the Royal Academy, he has produced a great number of scenes from Shakespeare, Molière, Dickens, Sterne, Goldsmith, etc., besides his immensely popular pictures, 'Coming of Age in the Olden Time' (1849); 'Life at the Sea-Side' (1854); 'The Derby Day' (1858); 'The Railway Station' (1862); 'Before Dinner at Boswell's Lodgings' (1868 — sold in 1875 for £4,567); 'The Private View at the Royal Academy' (1881), etc. He was commissioned by the queen to paint the marriage of the Prince of Wales. He was elected R.A. in 1852, and is a member of several foreign academies. His works do not exhibit the highest qualities of art, but, possibly in part because of this, they have been extremely popular. Large engravings have been produced from a number of his pictures. In 1887–8 he published his autobiography.

Fritillary, in botany, a plant of the genus *Fritillaria,* of the lily family, found in the North Temperate and Arctic zones. The plants are herbaceous, the leaves simple, alternate, though sometimes appearing opposite or verticillate; the flowers terminal and pendent; the perianth campanulate, of six petals; the stamens six; the style trifid. About a dozen species are known, several of which are cultivated in gardens, being hardy and highly ornamental plants. The *F. imperialis,* or crown imperial, supposed to be a native of Persia, has large orange or yellow flowers nodding beneath a terminal tuft of leaves. The bulb is poisonous, as is that of *F. meleagris,* though in a less degree.

Fritting Furnace, in glass-making, a reverberatory furnace in which the materials for making glass are calcined (fritted) as a process preliminary to melting. The object is to effect a partial union of the salicylic acid and alkali, to avoid volatilization in the latter in the subsequent vitrification. The materials (sand, chalk, soda-ash, and cullet) being introduced into the furnace, the temperature is gradually raised for three hours. The pasty mixture is stirred, and the temperature increased to incipient fusion. The frit is then raked out and transferred to the melting pot, or is placed in cast-iron trays, cut into blocks with a spade, and stored away as frit bricks. See GLASS.

Fritz, John, American iron and steel expert: b. Londonderry, Pa., 1822. He was at first a machinist in shops at Parkersburg and Norristown, and subsequently was a constructor of rolling-mills, acquiring in the latter capacity an authoritative knowledge of iron and steel manufacture. He equipped the Bethlehem iron and steel works, and was for many years manager of that well-known establishment. Many methods of manufacture now in general use were employed by Fritz among the first in this country, including the Bessemer process. Several manufacturers and scientists established in 1902 the award of the Fritz medal to be given for discovery in the fields of science.

Friuli, frē'oo-lē, **Italy,** a formerly independent duchy, consisting, in its widest extent, of the modern Italian province of Udine, the Austrian county of Görz and Gradiska, and the circle of Idria. It was one of the most important duchies of the Longobard Kingdom, and after the overthrow of that monarchy by Charlemagne, and even up to the 15th century, when it was conquered by Venice and its territories dismembered, it retained a considerable degree of independence. The inhabitants, called Furlani, are Italian for the most part, but speak a peculiar dialect, into which a strong Celtic element has been introduced. See ITALY.

Frobisher Bay, an Arctic inlet opening westward near the mouth of Davis Strait, at the southern end of Baffin Land. It is about 200 miles long by above 20 wide, with rugged mountainous shores. It was till Hall's voyage called Frobisher Strait, being erroneously regarded as a passage into Hudson Bay.

Froebel, Friedrich Wilhelm August, frēd'rĭH vĭl'hĕlm ow'goost frē'bĕl, German educationist: b. Oberweissbach, Thuringia, 21 April 1782; d. Marienthal 21 June 1852. It was Froebel who said, "The clearer the thread that runs through our lives backward to our childhood, the clearer will be our onward glance to the goal"; and in the fragment of autobiography he has left us, he illustrates forcibly the truth of his own saying. The motherless baby who plays alone in the village pastor's quiet house, the dreamy child who wanders solitary in the high-walled garden; the thoughtful lad, neglected, misunderstood, who forgets the harsh realities of life in pondering the mysteries of the flowers, the contradictions of existence, and the dogmas of orthodox theology; who decides in early boyhood that the pleasures of the senses are without enduring influence and therefore on no account to be eagerly pursued; — these presentments of himself, which he summons up for us from the past, show the vividness of his early recollections and indicate the course which the stream of his life is to run.

The coldness and injustice of the new mother who assumed control of the household when he was 4 years old, his isolation from other children, the merely casual notice he received from the busy father absorbed in his parish work, all tended to turn inward the tide of his mental and spiritual life. He studied himself, not only because it was the bent of his nature, but because he lacked outside objects of interest; and to this early habit of introspection we owe many of the valuable features of his educational philosophy. Whoever has learned thoroughly to understand one child, has conquered a spot of firm ground on which to rest while he studies the world of children; and because the great teacher realized this truth, because he longed to give to others the means of development denied him, he turns for us the heart-leaves of his boyhood.

It would appear that Froebel's characteristics were strongly marked and unusual from the beginning. Called by every one "a moon-struck child" in Oberweissbach, the village of his birth, he was just as unanimously considered "an old fool," when, crowned with the experience of 70 years, he played with the village children on the green hills of Thuringia. The intensity of his inward life, the white heat of his convictions, his absolute blindness to any selfish idea or aim, his enthusiasm, the exaltation of his spiritual nature, all furnish so many cogent reasons why the people of any day or of any community should have failed to understand him, and scorned what they could not comprehend. It is the old story of the seers and the prophets repeated as many times as they appear; for "these colossal souls," as Emerson said, "require a long focal distance to be seen."

At 10 years old the sensitive boy was fortunately removed from the uncongenial atmosphere of the parental household; and in his uncle's home he spent five free and happy years, being apprenticed at the end of this time to a forester in his native Thuringian woods. Then followed a year's course in the University of Jena, and four years spent in the study of farming, in clerical work of various kinds, and in land-surveying. All these employments, however, Froebel himself felt to be merely provisional; for like the hazel wand in the diviner's hand, his instinct was blindly seeking through these many restless years the well-spring of his life.

In Frankfort, where he had gone intending to study architecture, Destiny touched him on the shoulder, and he turned and knew her. Through a curious combination of circumstances he gained employment in Herr Gruner's Model School, and it was found at once that he was what the Germans love to call "a teacher by the grace of God." The first time he met his class of boys he tells us that he felt inexpressibly happy; the hazel wand had found the waters and was fixed at last. From this time on, all the events of his life were connected with his experience as a teacher. Impelled as soon as he had begun his work by a desire for more effective methods, he visited Yverdon, then the centre of educational thought, and studied with Pestalozzi. He went again in 1808, accompanied by three pupils, and spent two years there, alternately studying and teaching.

There was a year of lectures at Göttingen after this, and one at the University of Berlin, accompanied by unceasing study and research both in literary and scientific lines; but in the fateful year 1813 this quiet student life was broken in upon, for impelled by strong moral conviction, Froebel joined Baron von Lützow's famous volunteer corps, formed to harass the French by constant skirmishes and to encourage the smaller German States to rise against Napoleon.

No thirst for glory prompted this action, but a lofty conception of the office of the educator. How could any young man capable of bearing arms, Froebel says, become a teacher of children whose Fatherland he had refused to defend? how could he in after years incite his pupils to do something noble, something calling for sacrifice and unselfishness, without exposing himself to their derision and contempt? The reasoning was perfect, and he made practice follow upon the heels of theory as closely as he had always done since he became master of his fate.

After the Peace of Paris he settled down for a time to a quiet life in the mineralogical museum at the University of Berlin, his duties being the care, arrangement, and investigation of crystals. Surrounded thus by the exquisite formations whose development according to law is so perfect, whose obedience to the promptings of an inward ideal so complete, he could not but learn from their unconscious ethics to look into the depths of his own nature, and there recognize more clearly the purpose it was intended to work out.

In 1816 he quietly gave up his position, and taking as pupils five of his nephews, three of whom were fatherless, he entered upon his life work, the first step in which was the carrying out of his plan for a "Universal German Educational Institute." He was without money, of course, as he had always been and always would be,— his hands were made for giving not for getting; he slept in a barn on a wisp of straw while arranging for his first school at Griesheim; but outward things were so little real to him in comparison with the life of the spirit, that bodily privations seemed scarcely worth considering. The school at Keilhau, to which he soon removed, the institutions later established in Wartensee and Willisau, the orphanage in Burgdorf, all were most successful educationally, but, it is hardly necessary to say, were never a source of profit to their head and founder.

Through the twenty succeeding years, busy as he was in teaching, in lecturing, in writing, he was constantly shadowed by dissatisfaction with the foundation upon which he was building. A nebulous idea for the betterment of things was floating before him; but it was not until 1836 that it appeared to his eyes as a "definite truth." This definite truth, the discovery of his old age, was of course the kindergarten; and from this time until the end, all other work was laid aside, and his entire strength given to the consummate flower of his educational thought.

The first kindergarten was opened in 1837 at Blankenburg (where a memorial school is now conducted), and in 1850 the institution at Marienthal for the training of kindergartners was founded, Froebel remaining at its head until his death two years after.

With the exception of that remarkable book 'The Education of Man' (1826), his most important literary work was done after 1836; 'Pedagogics of the Kindergarten,' the first great European contribution to the subject of child-study, appearing from 1837 to 1840 in the form of separate essays, and the 'Mutter-und-Kose Lieder' (Mother-Play) in 1843. Many of his educational aphorisms and occasional speeches were preserved by his great disciple the Baroness von Marenholtz-Bülow in her 'Reminiscences of Froebel'; and though two most interesting volumes of his correspondence have been published, there remain a number of letters, as well as essays and educational sketches, not yet rendered into English.

Froebel's literary style is often stiff and involved, its phrases somewhat labored, and its substance exceedingly difficult to translate with spirit and fidelity; yet after all, his mannerisms are of a kind to which one easily becomes accustomed, and the kernel of his thought when

reached is found well worth the trouble of removing a layer of husk. He had always an infinitude of things to say, and they were all things of purpose and of meaning; but in writing, as well as in formal speaking, the language to clothe the thought came to him slowly and with difficulty. Yet it appears that in friendly private intercourse he spoke fluently, and one of his students reports that in his classes he was often "overpowering and sublime, the stream of his words pouring forth like fiery rain."

Froebel's educational creed cannot here be cited at length, but some of its fundamental articles are:

The education of the child should begin with its birth, and should be threefold, addressing the mental, spiritual, and physical natures.

It should be continued as it has begun, by appealing to the heart and the emotions as the starting-point of the human soul.

There should be sequence, orderly progression, and one continuous purpose throughout the entire scheme of education, from kindergarten to university.

Education should be conducted according to nature, and should be a free, spontaneous growth,— a development from within, never a prescription from without.

The training of the child should be conducted by means of the activities, needs, desires, and delights, which are the common heritage of childhood.

The child should be led from the beginning to feel that one life thrills through every manifestation of the universe, and that he is a part of all that is.

The object of education is the development of the human being in the totality of his powers as a child of nature, a child of man, and a child of God.

These principles of Froebel's, many of them the products of his own mind, others the pure gold of educational currency upon which he has but stamped his own image, are so true and so far-reaching that they have already begun to modify all education and are destined to work greater magic in the future. The great teacher's place in history may be determined, by-and-by, more by the wonderful uplift and impetus he gave to the whole educational world, than by the particular system of child-culture in connection with which he is best known to-day.

Judged by ordinary worldly standards, his life was an unsuccessful one, full of trials and privations, and empty of reward. His death-blow was doubtless struck by the prohibition of kindergartens in Prussia in 1851, an edict which remained nine years in force. His strength had been too sorely tried to resist this final crushing misfortune, and he passed away the following year. His body was borne to the grave through a heavy storm of wind and rain that seemed to symbolize the vicissitudes of his earthly days, while as a forecast of the future the sun shone out at the last moment, and the train of mourners looked back to see the low mound irradiated with glory.

In Thuringia, where the great child-lover was born, the kindergartens, his best memorials, cluster thickly now; and on the face of the cliffs that overhang the bridle-path across the Glockner Mountain may be seen in great letters the single word *Froebel*, hewn deep into the solid rock. Consult: von Marenholtz-Bülow, 'Reminiscences of Friedrich Froebel'; Barnard, 'Papers on Froebel's Kindergarten' (1881); Hauschmann, 'Froebel's Kindergarten System'; Bowen, 'Froebel' (1897); Quick, 'Educational Reformers.' NORA ARCHIBALD SMITH.

Frog. This familiar animal is the type of the anurous *Amphibia* (order *Anura*). The family *Ranidæ*, to which it belongs, is characterized by having the skin smooth, the hind legs long, and the feet usually completely webbed; teeth are present in the upper jaw and palate, seldom in the lower jaw. The tympanic membrane is situated behind the eyes, and is not concealed. The nostrils are placed at the extremity of the rounded muzzle just above its margin, and open directly into the mouth. When the mouth is filled with air the nostrils are closed, and the animal swallows the bolus of air into the sacculate lungs, there being, in the absence of ribs, no provision for such respiratory movements as take place in the chest of mammals. Frogs are thus air breathers, but they are capable of remaining for a considerable time under water. They swim with great vigor, and on land progress by a series of violent leaps, the long hind limbs being powerful levers. Their food is chiefly insects, which they capture by means of the tongue: this organ is covered with a viscid secretion and is attached in front, its free border being behind; it is rapidly projected from the mouth, the insect adheres to it, and is at once swallowed. The frog does not drink, but its soft skin absorbs fluids rapidly, and thus has a double function both of nutrition and as an aid to respiration. As the frog grows the old outer skin cracks from time to time, and is pulled off and swallowed. The animal retires in winter to the bottom of ponds, from which clusters of frogs may be drawn buried in mud. This hibernation, which is associated with low vital energy, ends in February; in March the spawn is deposited in gelatinous masses of many hundreds of eggs, the males riding for a long period at that season on the backs of the females, and fertilizing the eggs as fast as they are extruded. The eggs soon manifest change, and after a time the young escapes as a "tadpole," a larval animal with short body, circular suctorial mouth, and long tail, compressed from side to side. Gills project on either side of the head from a cleft which answers in position to the gill opening of fishes. The hind limbs first appear as buds, later the fore limbs project, the gills disappear, the lungs becoming more fully developed; the tail gradually shrinks and disappears, and the animal, which was at first fish-like, then closely resembled a newt (or urodele amphibian), finally assumes the adult or anurous form. This is a true process of metamorphosis as complete as that of the butterfly; since there is a change not merely of form and proportion, but also of internal organs. The frog is highest among *Amphibia*, and the successive stages of its development resemble each the adult form of a lower group in its line of ancestry.

Frogs, themselves useful in clearing gardens of slugs and insects, are in turn the prey of birds, especially herons and aquatic birds, of serpents, and fish, the latter destroying large quantities of the spawn. Though exposed to droughts, they can bury themselves in the moist

soil and thus live after the ponds are dried up. Though thus tenacious of life, the stories of frogs being found in stone and in trees are for the most part founded on imperfectly noted facts, though it is possible that a frog may now and then get closed into a cavity for which, after entering, it had grown too large; but an aperture must always be present by which water can get access to them. Their fossil history goes back to the early Tertiary days, and probably will be found to extend farther, as Eocene examples differ little from modern forms. See AMPHIBIA.

It is by no means easy to define the word «frog» in classification, as distinguished from «toad» (q.v.), and the safest method here will be to deal only with the aquatic family *Ranidæ*, already defined, accepted as the most highly developed of amphibians. It contains about 280 species and is represented in every part of the world not too cold except southern South America and Australia, where all the so-called frogs belong to a related family, the *Cystignathidæ*, whose members, especially of the sub-family *Cystignathinæ*, may be said to represent the *Ranidæ* in Notogæa. «Some of them,» says Gadow, «can be distinguished from the true, typical frogs solely by the arciferous type of the shoulder-girdle and sternum.

The type-genus *Rana* contains more than half the known species, and is scattered all over the northern hemisphere, but is absent from the southern. It is to this genus that the common frogs of Europe and the United States belong — the bull-frog, spring-frog, European grass-frog, etc. The American bull-frog (*R. catesbiana*) is the largest of the whole tribe, occasionally reaching a length of eight inches; and its muffled grunting cry may be heard a mile or more over the water. It is greenish bright upon the head and mottled elsewhere, while the legs are distinctly blotched. This species abounds in all sluggish waters from Kansas eastward, laying its eggs in long strings, and its tadpoles require two years to reach maturity. It is bold and voracious, catching fish, salamanders, other frogs and even ducklings. Its size and the chicken-like daintiness of the flesh in its hind legs, or «saddle,» make it the favorite frog for market, and great quantities are eaten in all parts of the country. In the springs, swamps and ditches lives the green frog (*R. clamata*), not half as big, but very similar in color except that it is yellowish or white below. Another green aquatic frog, still smaller, is the leopard frog (*R. virescens*), whose bright coat is marked with irregular blotches of black edged with whitish, in two rows along the back, and the legs are barred. This species is numerous everywhere as far west as the Sierra Nevada. Another checkered frog, confined to the Eastern States, is the pickerel frog (*R. palustris*), which is light-brown with two rows of large oblong square blotches of dark brown on the back, and one or two on the sides. The head is short, and a dark line extends from the nostril to the eye, while the upper jaw is white, spotted with black spots. Another well-known little kind is the wood-frog (*R. sylvatica*), which goes to the water to breed in early spring, but during most of the year lives in the dry woods. It is a variable reddish brown, with the side of the head marked with a dark brown band. Several other less conspicuous species of frog inhabit North America, including a few representatives of another family (*Engystomidæ*), besides the tree-frogs, elsewhere described.

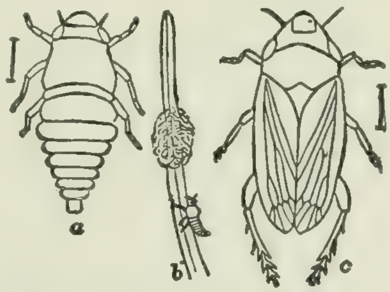
For frogs generally consult Gadow's 'Amphibia and Reptiles' (1901); for those of the United States the writings of Holbrook, C. C. Abbott, O. P. Hay, A. W. Butler, and especially 'North American Batrachia,' by E. D. Cope. See also AMPHIBIA; METACHROSIS.

Frog-mouths, a group of large Australian and Indian nightjars constituting the sub-family *Podarginæ* and remarkable for their huge mouths. The Australian More-pork (q.v.) is an example.

Frog-shell, a small mollusk of the *Triton* family (genus *Ranella*), so called because of its shape and mottled colors.

Frogfish, any of several sea-fishes of low organization, toad-like forms and carnivorous habits, constituting the family *Antennariidæ*, and related to the goosefish (q.v.), itself sometimes called «fishing frog.»

Froghoppers, or **Froth-flies,** minute plant-feeding homopterous bugs of the family *Cercopidæ*, which dwell upon plants and may, when very numerous, seriously damage grass-crops. The eggs are laid on the stems of plants in the autumn, and survive in the winter. When the embryos hatch (and these resemble the parents,



a, immature young (enlarged); *b*, froth about eggs, and young froghopper, natural size; *c*, adult (enlarged).

but are wingless) they exude a viscid liquid which is whipped into froth, called in England «cuckoo-spit,» by the thrashing of the «tail,» an anal appendage probably respiratory in function. The «spittle» is supposed to be a protective disguise, nevertheless the immature insects are preyed upon by wasps, etc. These bugs are called «froghoppers» in double allusion to the froth about their eggs and to their great leaping powers.

Froh'man, Charles, American theatrical manager: b. Sandusky, Ohio, 1858. Having managed several road companies, he took charge of the Empire Theatre, New York, in 1893, and in 1895–6 organized the syndicate which exercises so large a monopoly in American theatrical affairs.

Frohman, Daniel, American theatrical manager: b. Sandusky, Ohio, 1853. He began business life with five years in newspaper offices; he subsequently became manager of a traveling theatrical company, since which he has successfully managed several New York theatres, as well as English and American stars and theatrical companies. He is at present manager of the

Lyceum Theatre, Daly's Theatre, and the Daniel Frohman Stock Company.

Froissart, Jean, zhŏṅ frä-swä or froi'särt, French chronicler: b. Valenciennes, Hainault, 1333; d. Chimay 1419. He began at 20 to write the history of the wars of the time and made several journeys to examine the theatre of the events he was about to relate. His 'Chronicle' (as the title is usually abbreviated) covering the years 1326–1400, is of capital importance for its period. To a collection of the verses of Wenceslaus of Brabant, Froissart added some of his own, and gave to the whole the title 'Meliador, or the Knight of the Golden Sun.' All his extant poems were published at Brussels (1870–2). His chronicles form a work of permanent value, because of their accurate and impartial account of important events of the 14th century, and of the vivid pictures which they contain of the life of an age so strikingly different from our own. They narrate events connected with France, England, Scotland, Spain, Brittany, etc. See Darmesteter, 'Froissart' (1894).

Fromentin, Eugène, ė-zhān frō-mŏṅ-tăṅ, French painter: b. La Rochelle 24 Oct. 1820; d. St. Maurice, near La Rochelle, 27 Aug. 1876. He began life as a law student, but early turned his attention to landscape painting, working in the studio of Louis Sabat. In 1842 he traveled in Algeria, and it was after this journey that under the guidance of Marilhat, the painter of Oriental scenes, he resolved to work a new vein in the same department by painting the North African deserts. In 1847 he exhibited at the Salon for the first time and visited Algeria twice (1848–52). The fruits of these wanderings were not only numerous pictures, but also two literary works descriptive of his travels. These were: 'A Summer in the Sahara' (1856), and 'A Year in the Sahel' (1858), works distinguished by powerful and richly colored style, and poetic imagination. As a painter his aim was to depict the light and atmosphere of the desert with truth and delicacy, yet imparting to it his own subjective interpretation, and he showed a marked taste for studies in gray and violet. The masterly analysis of ancient painting, which appears in his 'Masters of a Former Day' (1876), embodies the results of his travels in Holland and Belgium (1875), where he made a careful study of the Dutch and Flemish masters.

Frommel, frō'mĕl, **Emil,** German theologian: b. Karlsruhe 5 Jan. 1828. He was an army chaplain, and published several theological works of importance. 'Tales For the People' (1873–86), and similar collections of humorous and realistic compositions, will more surely form his memorials in the future.

Fronde, frŏnd (Fr. frôṅd), the name of a political faction which played a conspicuous part in French history during the minority of Louis XIV., and gave rise to the insurrectionary movement known historically as the War of the Fronde. The members of this party obtained the contemptuous name of Frondeurs (slingers), being compared to boys throwing stones from slings, owing to the pertinacious lampoon warfare which they waged against the powerful minister of that day, Cardinal Mazarin, and the Queen Regent, Anne of Austria. Mazarin, as a foreigner and a parvenu, was detested by the French people — both patrician and proletarian — and especially had incurred the opposition of the Parliament of Paris to his measures. In 1648 Mazarin ventured on the bold step of arresting two of the most popular members of the latter body, and on the next day 27 August (*la journée des barricades*) the Parisians rose in arms, dispersed some of the royal troops sent out against them, and barricaded the approaches to the Louvre, compelling the court party to retire to St. Germain, thus leaving Paris in the hands of the insurgents. Upon the Prince de Condé advancing to besiege the capital, the parliament called the citizens to arms, when the Prince de Conti, the Duc de Beaufort, ("Le Roi des Halles," and son of Henry IV.), and numerous others of the great nobles of the kingdom, came forward to head the insurrection. The famous Cardinal de Retz and the Duchesses de Longueville and de Montbazon also joined the popular cause. The Prince de Condé, too, changed sides and went over to the malcontents, with whom the court party shortly afterward patched up a treaty of peace of but brief duration. Fresh contentions arose, and Mazarin caused the arrest of Condé and Conti. This step excited a revolt in the provinces, and Marshal Turenne hastened to the rescue of the Frondeur princes, but was routed in the battle of Rethel (1650). The cardinal, however, enjoyed but a temporary supremacy; the parliament again agitated against him, and procured his banishment from France, leaving the Prince de Condé master of the situation. Subsequently, the contest degenerated into a war of intrigue and is regarded as one of the most useless conflicts ever waged. The court finally agreeing to dismiss Mazarin a general amnesty was proclaimed. Condé attempted to continue the struggle, but was proscribed, and entered the service of Spain, while Mazarin, after a time, returned to Paris, and again obtained the reins of government.

Front Royal, Engagement at. Front Royal, Va., is 12 miles east of Strasburg, and is the key to Luray Valley. On 23 May 1862 it was held by Col. Kenly with 9 companies of the 1st Maryland infantry, 2 companies of the 29th Pennsylvania, a company of the 28th New York, and a section of Knap's battery, under command of Lieut. Atwell, in all about 900 men. Soon after noon of the 23d "Stonewall" Jackson, moving down the Luray Valley to cut off Bank's retreat from Strasburg to Winchester, pushed through the town, driving in Kenly's pickets and advance-guard. Kenly made a stand on a ridge about a mile north of the town, where he was joined by about 100 men of the 5th New York cavalry, but was soon flanked and pushed across both branches of the Shenandoah, and failed to burn the bridges behind him. When across the river he drew up on its north bank and, with artillery and musketry, resisted for some time all efforts to cross; but Jackson's cavalry forded the stream, both above and below the bridges, thus flanking his position, and Kenly fell back toward the cross-road leading to Middletown, closely followed by Confederate cavalry. He had gone four miles when his cavalry rear-guard was stampeded, and his infantry fiercely attacked, the resistance continuing until his force was cut to pieces and captured, with Atwell's two guns and the entire supply-train. Nearly all the New York cavalry escaped. The Union loss

was 18 killed, 56 wounded, and 718 captured; the Confederate loss was 11 killed and 15 wounded. Jackson pushed on after Banks, leaving Col. Conner with the 12th Georgia and a battery at Front Royal. On the 30th the 1st Rhode Island cavalry, the advance of McDowell's corps, dashed into the town, surprised Conner, and captured 156 officers and men and one gun, the loss in the cavalry being 8 killed and 5 wounded.

E. A. Carman.

Frontaura, frōn-tow'rä, **Carlos,** Spanish author: b. Madrid, Spain, 4 Sept. 1834. He published: 'The Philanthropist,' a comedy; 'Fortunes and Misfortunes of Rosita,' a novel.

Frontenac, Louis de Buade, loo-ē dė boo-äd frônt'näk, Comte de, French colonial officer: b. France 1620; d. Quebec 28 Nov. 1698. He entered the army in 1635, and at an early age became brigadier. In 1672 he was appointed governor of the French possessions in North America, to be recalled 10 years later, in consequence of endless quarrels with his intendant and the Jesuits. In spite of his violent temper he gained the confidence of the settlers and the respect of the Indians, and in 1689, when to the horror of constant attacks from the Iroquois the misery of a war with England was added, he was again sent out by the king, as the only man who could rouse the colonists to hope and action. During the next nine years he loosed his savage allies on the defenseless villages of New England, repulsed a British attack on Quebec, and so broke the power of the Iroquois that they were never again a terror to the colony. See Parkman, 'Frontenac and New France Under Louis XIV.' (1877); Winsor, 'Cartier to Frontenac' (1894).

Frontier Posts. See Northwest Territory.

Frontinus, frŏn tī'nŭs, **Sextus Julius,** Roman writer, who flourished in the second half of the 1st century after Christ. He was thrice consul, and commanded with reputation in Britain, under Vespasian. He was appointed by Nerva to superintend the aqueducts of Rome, and left an extant work on this subject, 'De Aquis Urbis Romæ,' as well as one dealing with the art of war, 'Strategemata.'

Fron'to, Marcus Cornelius, Roman orator and rhetorician: b. Cirta, a Roman colony in Numidia, about 100 A.D.; d. about 175. He went to Rome during the reign of Hadrian, soon acquired great fame as a speaker and teacher of rhetoric, and was in consequence selected as tutor to M. Annius Verus and L. Commodus, afterward emperors under the names Marcus Aurelius and Lucius Verus. He became a member of the senate, and was a consul in 143 A.D. Till 1814 the only extant writings of Fronto were a worthless tract, 'De Differentiis Vocabulorum' and some fragments; but in that year Angelo Mai recovered many of Fronto's letters from a palimpsest in the Ambrosian library at Milan. These were part of the orator's correspondence with Antoninus Pius, Marcus Aurelius, Lucius Verus, and other distinguished friends, and were published under Mai's editorship in 1815. In 1823 Mai published a new edition of the letters, containing many others which he had discovered in the Vatican library, but the standard edition is that of Naber (Leipsic 1867).

Frost, William Goodell, American educator: b. Le Roy, N. Y., 2 July 1854. He was graduated at Oberlin College in 1876, and afterward studied at Harvard and Göttingen, Germany. He was appointed professor of Greek in Oberlin College in 1879, and president of Berea College 1893. He has published: 'Inductive Studies in Oratory'; 'Greek Primer.'

Frost, the moisture in the atmosphere crystallized or congealed by the cold, upon the earth's surface, or upon various objects and surfaces situated or existing upon it, as grasses, shrubs, trees, window panes, etc. The various phenomena of hoar frost, window frost, etc., grouped under this head, occur over a large portion of the land surface of the earth. In the United States, hoar frosts often occur during the spring and autumn months, over the whole northern portion of the country, and more rarely also in the Southern States, sometimes causing much damage by freezing and injuring the young corn sprouts and early fruits and vegetables. Frosts occur only during calm, cold nights when the temperature falls below 32° F. In the United States the meteorological conditions usually preceding the formation of frosts are northerly winds, accompanied by high barometer, and especially the coincidence of these conditions with the near approach, or passing, of a storm from the west or southwest. The formation of hoar frost depends in some degree upon surface topography and local causes, occurring much more frequently within the deep valleys leading down from mountain heights, than in broader valleys or level regions. In the former, during calm cold nights, the cold air of the hill and mountain tops, by virtue of its greater specific gravity, flows down and mixes with, or flows underneath and replaces, the warmer, lighter air of the valleys, thus furnishing the conditions favorable to frost formation. The cooling of objects by radiation of heat, and by the evaporation of moisture from them, greatly facilitates the formation of frost. Frost crystallizations exhibit a wonderful variety, both of form and structure. The formation of each of the various types seems to depend upon a great number of meteorological and other conditions, some of them obscure. The temperature of the air, its electric condition, humidity, etc., and also the nature of the substances upon which they form, each seem to exert an influence in determining and modifying their form and structure. Two principal types of hoar frost occur,— the columnar, and the tabular. Commonly, both varieties do not occur simultaneously, but on a given night one or the other type will greatly predominate and form the bulk of the crystals. Frost crystallizations in general greatly resemble those of snow, but because their development is usually restricted in one or more directions by the objects or surfaces upon which they form, the resemblance is segmentary, rather than complete. In general, columnar forms vary from similar snow crystallizations, by virtue of their hollow cylindrical, or cup-like character, and by often attaining to much greater dimensions. Sometimes, during extreme cold, such forms attain a length of many inches. Tabular forms rarely attain perfect symmetry, but exhibit within them air tubes and inclusions, assume crystal forms possessing both close and open structure, and develop upon the

same extremely thin plane as do similar snow crystals. As commonly deposited in spring or autumn, they do not usually greatly exceed in size similar snow forms, but during intense and prolonged cold, as in winter, they attain much greater dimensions. A very beautiful effect is sometimes produced by the deposition upon the trees, shrubs, etc., of a heavy coat of hoar frost. Each limb and leaf and delicate twig is transformed and beautified, and presents a white appearance, as though frosted with silver. During zero weather, large and delicately formed branching tabular crystals, and long, icy needles, form in beautiful pendent clusters upon, and depend from, the rafters and timbers of barns, etc., close to where domestic animals are kept; and also upon ferns and similar plants overhanging icy terraces or ice-covered pools. Similar forms also form directly upon or project from icy surfaces. Even the clouds furnish their quota of frost crystallizations. When low-lying clouds enshroud mountain tops covered by forests, they often deposit a portion of their moisture upon the branches of the trees, commonly in the form of long, granular or fibrous needle-shaped crystals. Fogs, when they occur during hoar frost formation, usually deposit moisture upon the forming crystals in granular form. The most beautiful and varied frost crystallizations are those that form upon the window panes of dwelling houses, etc., in arctic or temperate zones. These fairy-like creations, seemingly in imitation of leaves, feathers, ferns, trees, starry firmaments, tropical forest effects, etc., occur as three distinct entities: the granular, the crystalline, and the membraneous. The latter variety forms only in heated rooms, upon window panes covered with an uncongealed film of water, as a dew-like condensation of moisture. It occurs most frequently in the form of long, curving, feather-like forms, or as an exceedingly delicate membranaceous-like network of diverging and coalescing lines. It is due to a process of crystallization that takes place during the conversion of a film of water into ice. The crystalline variety of window frost forms only upon window panes that are free from water in liquid form. Crystals of this class assume branching, star-like forms (often as four- or six-pointed branching stars), curving filaments, fibrous crystallizations, and those resembling sea-moss, long serrated lines, etc. Many of these are very beautiful and interesting. Some of them develop within minute striations in the surface of the glass and will reappear in the same identical positions upon a given pane, with each renewal. When identical meteorological and other conditions recur again and again, the types of frost coexistent with each will, in general, recur simultaneously with them. During zero weather, if conditions are favorable, the formation and growth of these beautiful frost creations takes place very rapidly. A beautiful and absorbingly interesting experiment consists in melting a heavy coat of window frost off a portion of a window pane (by placing an oil lamp close to it). Only the central portion of the pane should be cleared of all moisture; around this a film of water should be left upon the glass. Soon after the lamp is removed the feather-like membraneous frost will form around the outer edges of the film of water, and quickly radiate in beautiful curves toward the centre of the pane. They stop instantly when they reach the clear glass. Soon minute and delicate serrated crystal lines, or tiny crystal stars, appear upon the clear glass space, and slowly develop, and usually coexistent with them, a thin film of granular texture will be laid down upon portions of the clear glass. The latter is not usually deposited in slow progressive order, but in intermittent order. Large spaces of the clear glass are often covered simultaneously, by a succession of auroral-like flashes; each flash, in the twinkling of an eye, spreading a thin granular film upon unoccupied portions of the glass. Singularly enough, the granular deposit does not form near where the true crystalline frost is, the latter repels the former and prevents its formation upon the spaces immediately surrounding it.

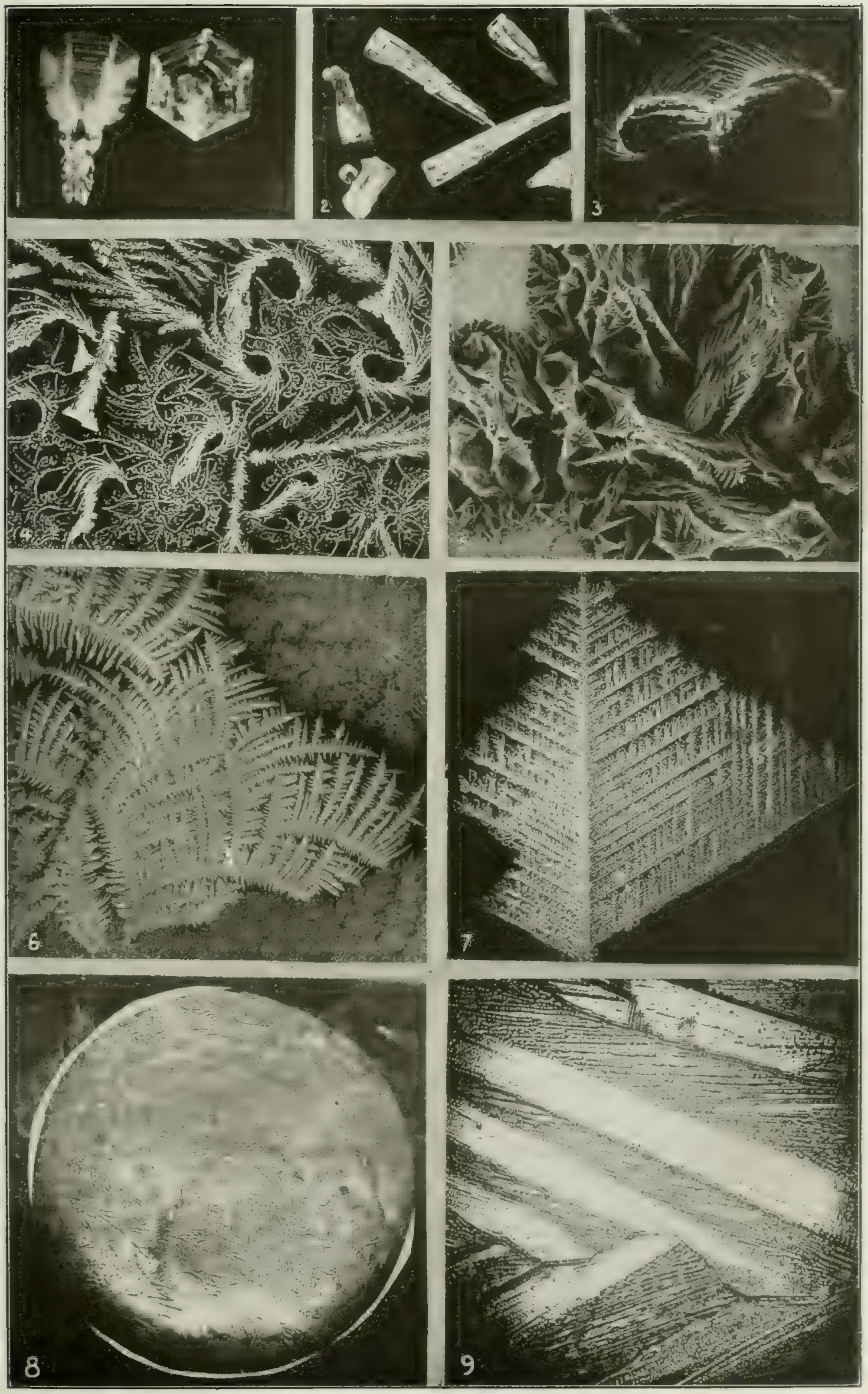
The phenomena included under the title frost, as commonly accepted, are understood to include both the processes of freezing and the mechanical effects produced thereby. Considered under this broad definition, frost plays an important part in the economy of nature, both beneficent and otherwise. It enters the crevices and minute cracks in the rocks and rends the rocks apart; and is thus an important agent in aiding and hastening their disintegration, and in converting them and the solid materials of the earth into soil. Its beneficent action in loosening and pulverizing the soil, by entering it and forcing the particles of compacted soil and clods apart through its expansive action upon the particles of moisture disseminated therein, is well known, and is of inestimable value to agriculture and to humanity. The damage sometimes done to vegetation, trees, etc., through the frosts entering them, and rending their fibres, cells, etc., apart, is often very great, and partial failures of crops such as corn, vegetables, fruits, etc., are due to this cause. As any considerable motion of air, the presence of clouds covering the sky, or the placing of a light covering, as of cloth or similar material, over the objects to be protected, greatly reduces or prevents the formation of frost upon them and of injury thereby, artificial preventives are often resorted to. Sometimes smoke-producing fires are built around or within enclosures or fields containing plants, fruits, or vegetables, and light, tent-like coverings are placed over small fruit trees, shrubs, etc., and other tender vegetable or plant growths, and thus the damage by frosts is prevented, or minimized. See also SNOW.

W. A. BENTLEY,
Author of 'Snow and Snow Crystals.'

Frost, Arthur Burdett, American illustrator and author: b. Philadelphia 19 Jan. 1851. He studied under Thomas Eakins in the Academy of Fine Arts, Philadelphia, and coming to New York secured employment on the 'Graphic,' and later entered the studio of Harper and Brothers. In 1877 he went to England, and in 1900 he exhibited at the Paris Exposition. His early work was full of interest and attracted much attention, and his later work showed the spirit of the true artist. He has published: 'Stuff and Nonsense' (1888); 'Bull Calf and Other Tales' (1892); 'Sports and Games in the Open'; and 'Golfers' Alphabet.'

Frost-bird, or **Frost-snipe**, a stilt sandpiper (q.v.).

Frost-bite. See CHILBLAIN; COLD.



1. Columnar window frost.
2. The same, cup-like.
3, 4, 5, 7. Crystalline window frost.
6. Branching hoar frost.
8, 9. Membranous window frost, highly magnified.

Frost-fish, a name given to various fishes, because they appear at the time of early frost, as does the tomcod (q.v.) so called in New England. The frost-fish of New Zealand is one of the scabbard-fishes (q.v.).

Frostburg, Md., a town in Allegany County, picturesquely situated on the Cumberland & P. R.R.; about 2,200 feet above the level of the sea. It has large foundries, planing-mills, and fire-brick works, and an extensive trade in coal. The city controls its own water supply. The government is controlled by a mayor, chosen annually, and a city council, both provided for under the charter of 1870. Pop. (1900) 5,274.

Froth-fly, or **Froth-hopper**. See FROGHOPPER.

Froth'ingham, Arthur Lincoln, American archæologist: b. Boston, Mass., 21 June 1859. He was educated in Rome, Italy, and at Leipsic; lectured on archæology at Johns Hopkins University in 1882–6; and became professor of archæology and the history of art at Princeton University in 1887. He founded the 'American Journal of Archæology' in 1885; and was associate director of the American School of Classical Studies, Rome, in 1895–6. His publications include: 'A History of Sculpture'; 'Mediæval Art Inventories of the Vatican,' and various monographs on Syria.

Frothingham, Ellen, American translator: b. Boston, Mass., 25 March 1835; d. there 11 March 1902. She was a daughter of Rev. N. L. Frothingham (q.v.) and inherited strong literary tastes, particularly in the direction of German literature. Her first published work was a translation of 'Nathan der Weise' (1868), usually ranked as the best English version of Lessing's famous drama. She also published translations of Goethe's 'Hermann und Dorothea' (1870); Lessing's 'Laokoon' (1874); Grillparzer's 'Sappho' (1876); Marie-Herbert's 'Poems of Therese' (1899).

Frothingham, Nathaniel Langdon, American Unitarian clergyman and religous writer: b. Boston, Mass., 23 July 1793; d. there 4 April 1870. He was graduated from Harvard in 1812 and entering the ministry was pastor of the First Church in Boston 1815–50. He was author of: 'Deism or Christianity'; 'Sermons in the Order of a Twelvemonth' (1852); and 'Metrical Pieces' (1855–70). He was one of the earliest American students of German. His writings are marked by grace and refinement.

Frothingham, Octavius Brooks, American clergyman: b. Boston, Mass., 26 Nov. 1822; d. there 27 Nov. 1895. He was a son of N. L. Frothingham (q.v.), and was graduated from Harvard in 1843, and from the Cambridge Divinity School in 1846. His radical views led to the resignation of his pastorate in the North Unitarian Church, Salem, Mass. He was pastor in Jersey City 1855–9; then organized the Third Unitarian Church in New York, where he preached very radical and advanced views till his resignation in 1879. The remainder of his life was devoted to travel and literary pursuits, his home being in Boston. His works were: 'Stories from the Lips of the Teacher'; 'Stories from the Old Testament'; 'The Religion of Humanity'; 'The Cradle of the Christ'; 'Memoir of W. H. Channing'; 'The Safest Creed'; 'Beliefs of the Unbelievers'; 'Creed and Conduct'; 'The Spirit of the New Faith'; 'The Rising and the Setting Faith'; 'Lives of Gerrit Smith, George Ripley, Theodore Parker'; 'Transcendentalism in New England'; 'Recollections and Impressions'; etc.

Frothingham, Richard, American historian: b. Charlestown, Mass., 31 Jan. 1812; d. 1880. He was at various times a member of the State legislature, was mayor of Charlestown 1851–3, and managing editor of the Boston *Post* 1852–65. He published: 'History of Charlestown' (1848); 'History of the Siege of Boston' (1849); 'Life and Times of Gen. Joseph Warren' (1865); 'The Rise of the Republic of the United States' (1871).

Froude, frood, **James Anthony**, English historian: b. Dartington, Devonshire, England, 23 April 1818; d. Salcombe, Devonshire, 20 Oct. 1894. He was the youngest son of Archdeacon R. H. Froude, rector of Dartington, and was educated at Westminster and Oxford. His brother, Hurrell Froude, was one of the leaders in the "Oxford Movement" and both were influenced by Newman, the earliest work of the younger Froude being a contribution to the 'Lives of the Saints,' edited by Newman. He soon emerged from Tractarian influence, however, and for the rest of his life remained indifferent to the Church in which he had been reared. The first two volumes of his history of England appeared in 1856 and at once attracted marked attention, both favorable and adverse, on account of the brilliant style and the audacity of the writer's opinions. The book flatly reversed many historical judgments, and interpreted motives in a manner more common now than then, but very startling to readers in the middle of the 19th century. His attempted vindication of Henry VIII. must be accounted a failure, brilliant and able as it is, and although it is a most striking portrait of Henry that he has painted, it cannot be called a faithful likeness. His treatment of Mary of Scotland is certainly hostile, and has been met with severe criticism. His judgment of Elizabeth, though far from impartial, is more nearly accurate than that of either of the other two personages. He excelled in vigorous, dramatic presentation of men and events, and in the judgment of sober critics appears to have cared much more for picturesque narrative than for absolute historical accuracy. As a historian he will long continue to be read and admired, but his apparent indifference to historical truth at times will not permit of his inclusion in the first rank of historians. He visited the United States in 1872 on a lecture tour, his lectures being afterward published with the title of 'English Misrule in Ireland.' In 1874 he visited South Africa, his impressions being later given to the world in lectures at Edinburgh, and in 1882 made an extended tour through Australia, the West Indies and the United States, the literary outcome of which were: 'Oceana' and 'The English in the West Indies.' He was the friend of Carlyle, whose literary executor he became, and his life of the Sage of Chelsea, his 'Reminiscences of Carlyle' and 'Letters and Memorials of Jane Carlyle' have excited a vast amount of controversy. In 1892 Froude succeeded the historian Freeman as regius professor of history at Oxford, his lectures in that capacity

afterward constituting his volume on Erasmus. It may be said that Froude was more distinctly a man of letters than a historian. He is always readable even when one is forced to dissent from him most strongly, but he touched on too many themes to give to the writing of history the devotion toward it so characteristic of such men as the late Samuel Rawson Gardner, Prof. Freeman, or John Richard Green, and he was temperamentally indifferent to the claims of entire truthfulness. He may not have consciously distorted facts, but his selection of certain details and suppression of others for the apparent sake of making the particular hero in question brighter, or the particular villain darker, does not commend itself to the lover of truth for its own sake. His important works include: 'Shadows of the Clouds,' published under the pseudonym "ZETA" (1847); 'The Nemesis of Faith' (1848); 'The Book of Job' (1851); 'The History of England from the Fall of Wolsey to the Death of Elizabeth' (1856–70); 'Short Studies on Great Subjects' (1867); 'Inaugural Address Delivered to the University of St. Andrews' (1869); 'The Cat's Pilgrimage' (1870); 'Short Studies: Second Series' (1871); 'Calvinism' (1871); 'The English in Ireland in the 18th Century' (1872–4); 'Short Studies: Third Series' (1877); 'Life and Times of Thomas Becket' (1878); 'Cæsar: a Sketch' (1879); 'Bunyan' (1880); 'Two Lectures on South Africa' (1880); 'Reminiscences of the High Church Revival' (1881); 'Short Studies: Fourth Series' (1882); 'Reminiscences of Thomas Carlyle' (edited 1881); 'Thomas Carlyle: History of the First Forty Years of his Life' (1882); 'Letters and Memorials of Jane Welsh Carlyle' (edited 1883); 'Thomas Carlyle: History of his Life in London 1831–81' (1884); 'Life of Lord Beaconsfield' (1890); 'The Divorce of Catharine of Aragon' (1891); 'Life and Letters of Erasmus' (1894). The first two volumes named above he attempted to suppress in later life, and succeeded with 'The Shadow of the Clouds,' which cannot now be found anywhere.

Frozen Strait, the passage which connects Repulse Bay and Fox Channel, and separates Melville Peninsula and Southampton Islands. It is from 10 to 20 miles wide and in lat. 65° N. This strait is frozen, as its name indicates, nearly all the year, although some bodies of water farther north are free from ice from two to five months each year.

Fructidor, frük-tē-dōr, signifying the month of fruit and gold, was the name in the French republican calendar of 1792–1806, for the 12th month of the republican year. It commenced on 18 August and ended on 16 September, and was the third summer month.

Fruit, that part of a plant in which the seed or other reproductive element is perfected; in ordinary plants the matured ovary with its pericarp and other parts. This botanical usage is largely extended in popular usage, with the central idea that the fruit is a product of the plant useful to man.

Formation of Fruit.— Starting with those simplest flowers in which all the carpels are separate, we find the stigma and style usually withering back as no longer of service, and the ovary enlarging, as the fertilized ovules grow up into seeds. But in many such simple flowers more ovules are produced than are fertilized, and generally also more fertilized than can be developed up to maturity; hence the reduction of the ovules is exceedingly common, as is simply exemplified in the horse-chestnut.

A second principle of fruit-making is reached through keeping in mind the origin of the ovary from one or more carpellary leaves, of which the individual development has been so greatly checked that they remain closed upon the ovules, and frequently even coalesce with each other from the base upward, so forming a many-celled ovary. Yet the tendency to their individual expansion is not lost; in many monstrosities, and normally a few types, such as the common mignonette, the carpellary leaves early begin to expand, so opening the ovary and exposing the seeds long before ripeness. Far more frequently, however, this final development of the carpellary leaves is delayed until the growth-processes of the seed and fruit have ended, and it is, therefore, accompanied, or even preceded, by their death; the separation often indicating the lines at once of leaf-margin and leaf-fall.

In the best-developed carpellary leaves, such as those of the more floral *Ranunculaceæ,* we naturally find the ovary opening along the line of its united ovule-bearing margins. This is what is termed a follicle.

Since, however, the ovules are on the united margins, the midrib tends to interpose little or no resistance to a tendency to split or tear along its fold. Such "dehiscence by both dorsal and ventral suture" gives us the legume or pod. Another type is the *siliqua* (or when shortened and broadened the *silicula*) of *Cruciferæ.* Here the placental edges of two united carpels develop a transverse septum which divides the fruit; and this is left when the lobes split away, as so familiarly in honesty.

Among united ovaries which readily split open at the united margins (*septicidal*) we may note that of gentian (q.v.), while the more familiar three-celled ovary of a violet, with its parietal placentation, gives a characteristic example of dehiscence along the midribs of the united carpels, so opening the loculi (*loculicidal*). In the five-celled capsule of the geranium (q.v.) the carpellary leaves separate not only at the sides but also at the base, so curling inwards

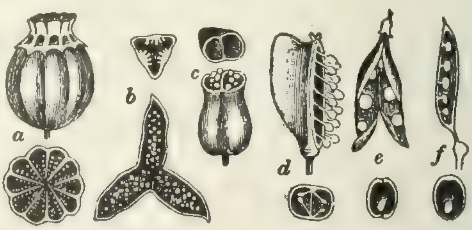


FIG. 1.— *f,* follicle; *e,* legume; *d.* silicula; *c,* capsule of henbane; *b,* of violet; *a,* of poppy.

and projecting the seed. Where, however, the placentæ remain more or less completely upon a central column from which the valves are detached, the dehiscence is said to be septifragal.

In henbane (*Anagallis*), etc., the dehiscence is circular (*circumscissile*). Many-celled capsules are numerous in which the leaf-opening or dehiscence is greatly reduced from completeness; witness the valvular and porous dehiscence

of the *Lychnis* and of the poppy respectively. Such cases clearly point us to those of carpels which do not open at all. Such indehiscent fruits, produced from carpels so persistently embryonic, are usually short, few or one-ovuled, and, for the most part, little specialized. Thus the follicle of the *Ranunculaceæ* of more specialized floral character becomes shortened into the one-seeded indehiscent *achene* of the anemone or buttercup. In the achene of the grasses (which similarly represents the capsule of the ancestral lilies) the thin dry pericarp becomes inseparable from the seed-coat (hence the term caryopsis); in many trees (for example, hazel) it becomes hardened and thickened as a nut. In composites, too, the achene is practically a nutlet, although often (on account of its being inferior) superfluously termed a cypsela. Less extremely reduced representatives of the various multicellular ovaries to which such fruits correspond are afforded us by borages or labiates, in which the two-celled ovary of the primitive solanaceous type becomes, as in thorn-apple, etc., subsequently divided into four parts. In *Umbelliferæ* we have another characteristic form of schizocarp, as all such fruits are termed which split up without truly carpellary dehis-

FIG. 2.— *e, f*, achenes of buttercup; *c, d*, caryopsis of oat; *a, b*, achenes with pappus; *g*, "lomentum"; *i, h*, nutlets and ovary of borage; *l, k*, umbelliferous type of schizocarp.

cence, although the tendency to this can be seen still to have some influence. Here the separate portions (or mericarps), each resembling an achene or nut, are two in number, and when ripe swing off upon the ends of a forked carpophore.

So far all our fruits have been dry; but a new physiological "principle of fruit-making" is necessary to comprehend those in which the pericarp is succulent. For, just as the effect of fertilization is seen in many animals to extend beyond the mere ovum to the parent organism, and also in many of the lowest plants, so it is in the case before us. Even in fruits which are dry on ripening we have seen that the ovaries or loculi, on which no demand is made for the growth of fertilized ovules, become reduced or disappear. Sometimes it may be merely the coats of the seed (as in the pomegranate) which undergo the complex histological and chemical changes which we sum up as those of succulence and ripening; at other times largely their placentas, as in the gooseberry and currant. Yet, as in these, the innermost tissue of the ovary may become succulent as well. In the orange also the familiar succulent tissue in which the seeds are immersed are the enlarged succulent cells of the endocarp; the grape, too, gives a characteristic example of soft endocarp. These

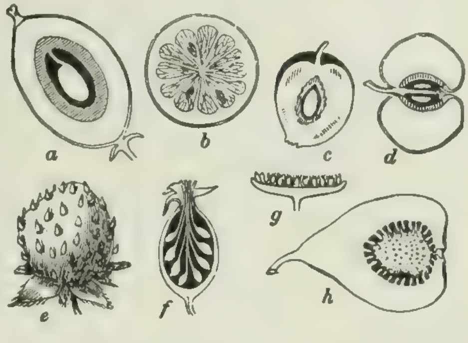


FIG. 3.— *a*, drupe; *b*, orange; *c*, a single drupelet of bramble; *d*, pome; *e*, strawberry; *f*, hip of rose; *g*, capitulum of Dorstenia; *h*, fig.

may all be classed as berries or baccate fruits, for the distinction of the succulent product of an inferior ovary as a berry, from that of a superior one, as a uva or grape, need hardly be allowed to increase our nomenclature. A pepo is merely a berry in which the epicarp is thick and tough (for example, a melon, with which the orange and pomegranate may be reckoned). Where the succulent change, instead of primarily affecting the deeper tissues of the fruit, and so producing a berry, leaves the endocarp hard, we have the drupaceous or stone-fruit. The endocarp here forms a more or less complete "stone" around the kernel or seed, the difference from an ordinary nut being due to the succulence of an outer layer (mesocarp), with a more or less leathery outer skin, the epicarp. The plum, peach, and nectarine are the most obvious examples; but, since we may have many carpels thus transformed, we may have an aggregate fruit or syncarp of tiny drupes. The walnut and even cocoanut are hence not true nuts (see NUT). The immature succulent mesocarp of the former is familiar in pickles, the walnut we crack being merely the stony endocarp (which is exceptionally specialized in being set free by the bursting of the mesocarp on ripening). The familiar cocoanut fibre is the fibro-vascular tissue of the mesocarp, the fruit being thus broadly comparable to a peach which has wizened while still young and stringy. But, as in the kindred grass, the coats of the ovule further unite to the endocarp.

The numerous carpels of the strawberry, although, of course, corresponding to those of the allied raspberry, remain mere nuts; here, however, the subjacent portion of the floral axis or receptacle becomes succulent. In the perigynous or epigynous *Rosaceæ* the same change may take place; hence the rose-hip is a succulent axis, enclosing a multitude of nuts. The apple or "pome" is more akin to the drupe, since the carpels, here deeply sunk in the upgrown floral axis, develop a hard endocarp corresponding to the stone of a drupe.

Fertilization may even be followed by succulent or other thickening of the floral envelopes, or of the floral axis with subjacent bracts — the

various cupules, as of acorn, beech, hazel-nut, etc., being of this nature. Or we may have a spurious fruit developed at the expense of an entire inflorescence, as in the pineapple, Dorstenia, and fig.

Chemical Composition of Fruits.— Our knowledge of the chemistry of fruit may be dated from the analyses of Fresenius (1857). But because of the innumerable varieties of almost every cultivated fruit, the effects of different soils and climates upon these, and still more of the fluctuation due to better or worse seasons, the results of any one chemical analysis would tend to convey an idea of undue precision. Thus — for example, while the ratio of sugar to free acid in certain grapes of an ordinary wine-year was found to be 16 to 1, in a very bad year it sank to 12, and in a very good year rose to 24. Hence a broad outline may be of more general use than the statistics of any one analysis.

The percentage of water may be taken as varying from 78 to 80 in the grape and cherry, as from 82 to 85 in plums, peaches, apples, and pears, as 82 to 87 in brambles, currants, etc., and as much as 95 in the watermelon. The proportion of insoluble residue — skin and cellulose, stone and seed — obviously also varies greatly with succulence and ripeness, but may be taken, one fruit with another, at not less than from 4 to 6 per cent. Unripe fruits may contain a notable proportion of starch, but this is fermented on ripening into glucose and other sugars, fruit-sugar, grape-sugar, cane-sugar, or (in *Sorbus*) sorbin. The only fruits which retain starch in important quantity are those of the banana, breadfruit-tree, and baobab; hence the exceptional nutritive value of these. The olive alone yields a notable proportion of oil. The proportion of sugars varies exceedingly, dates, dry figs (48 per cent), and raisins (56 per cent), again very important foods, heading the list. Grapes, of course, stand high, from 12 to 18, indeed sometimes as much as 26 per cent, cherries from 8 to 13, apples 6 to 8, pears 7 to 8, plums 6, red currants 4.75, greengage 3.5, peach and apricot only 1.5. The proportion of pectin bodies is, however, exceedingly notable, especially in fruits such as the three last named. In unripe fruits (as also in roots) we find pectose, a body apparently related to cellulose, but easily transmuted by a natural ferment or by boiling with dilute acid into pectin, $C_4H_6O_4$, and its allies. These are all more or less soluble in water, with which they readily form a jelly (whence the peculiar consistency of our fruit-preserves). The proportion of soluble pectin and gum varies considerably and is of great importance to the blandness and agreeableness of fruit, the harder and more common apples having considerably less than 3 per cent and the best rennets nearly 8. The harsh red currant, indeed, like berries in general, has exceedingly little (0.25 per cent); while the apricot has as much as 9, the greengage 12, and the peach 16 — a circumstance which explains the peculiarly melting quality of these fruits, especially the last-named. The free acid also varies greatly, from 2.4 per cent in the red currant, 1.4 in the raspberry, and nearly as much in the sourest cherries, to 0.5 in sweet cherries and a minimum of 0.1 or less in the sweetest pears. That of apples and of grapes, of course, varies greatly, but both may generally be taken at from 1 to 0.75, while the apricot and peach stand at 0.3 or 0.4. The acid is primarily malic, but citric, acetic, oxalic, tannic, and others may also be present.

The quantity of albuminoids is of course small, in fact, inadequate to render most fruits a staple food. Yet it is by no means inappreciable, ranging from nearly .5 per cent in the majority of fruits to .7 or .8 in the grape (2.7 in raisins), and above 1 in the melon and tomato. Hence to acquire albuminoids equal to those of one egg we must eat 1½ pounds of grapes, 2 pounds strawberries, 2½ pounds apples, or 4 pounds pears. To replace 1 pound starch = 5½ pounds potatoes, we need 5.4 pounds grapes, 6.7 of cherries or apples, or 12.3 of strawberries. See FOOD.

The quality of fruits depends largely upon the proportion of sugar, gum, and pectin to free acid, largely also upon the proportion of soluble to insoluble matters, but in very great measure also upon the aroma. This quality is due to the presence of characteristic ethers, often accompanied by essential oils, although not of course in ponderable percentage. Cultivation and selection operate strongly on all three factors.

Keeping of Fruit.— Many of the finest fruits undergo very speedy decomposition, which, as distinguished from the intrinsic processes of ripening, is due to the attacks of bacteria, molds, or yeasts; and the problem of their preservation is therefore primarily one of preventing these. In damp and stagnant air, especially with considerable or frequent changes of temperature, these fungus pests multiply with special readiness; hence a fruit-room must be cool and shady, yet dry and airy, and the fruit carefully gathered rather before full ripeness, handled so as to avoid in any way bruising or tearing the skin, and laid out and occasionally looked over so that rottenness in one may not affect the rest. Under these conditions apples especially may be kept for many months; indeed many varieties of fruit — for example, winter-pears — require these conditions for satisfactory ripening. On antiseptic principles we see how it is that the dense-skinned and wax-coated grape can be so largely imported in sawdust, or how unripe gooseberries, and even very perishable pears can be kept for months similarly packed in well-sealed jars in a cool place. The process of preserving with sugar in jars promptly covered up is similarly an antiseptic one; but in the systematic application of antiseptic principles we may still look for considerable progress in the preservation and transport of fresh fruit upon a large scale. The method of drying fruit has also been in use from remote times, especially with dates, figs, and raisins.

See CIDER; FRUIT, CULTIVATION OF; FRUIT TRADE, THE AMERICAN; FRUITS, COLD STORAGE OF; GARDEN; and articles on the various fruits, as APPLE, CHERRY, PEACH, etc.

Consult works on fruit-culture by Bailey (1897); Burbidge (1881); Cheal (new ed. 1892); Downing; Du Breuil (1886); Fish (1882); Fuller (1881); Hogg (1885); Roe (1886); Thomson (1881); Wood (1880).

Fruit, Cultivation of, the planting, protecting and ripening of fruit for food. The skilful labor of the cultivator has so greatly improved the original indigenous wild fruit of different zones, that it is worth while to consider from the beginning this gradual process of

amelioration. In the tropics, the fruits grow spontaneously with little need for cultivation. The plantain and banana, the guava and sapodilla yield their refreshing fruit without the aid of man. In temperate climates the wild fruits are scarcely edible. Wild cherries, crab-apples, and wild grapes are harsh and sour. By cultivation the crab is changed into the golden pippin, the wild pear into a Bergamotte, and the wild grape into a Concord cluster. There are two or three axioms which underlie all principles of successful fruit culture. The wild fruits if left in their natural state reproduce themselves only. The first step is to domesticate a new generation by sowing their seeds amid new conditions. Take for instance the common wild cherry (*Cerasus avium*). Plant its seed in garden soil and a tree of a different kind appears; each seedling differs from the original plant, and some few will be superior to it. When once this variety appears, selection of the best among many will gradually lead to perfection. This perfection we see in the pears, apples, grapes, and plums of to-day. But only by assiduous care can the present standard be kept up. «There can be no doubt,» says Dr. Lindley, «that if the arts of cultivation were abandoned for only a few years, all the annual varieties of plants in our gardens would disappear and be replaced by a few wild forms.» Hence the necessity for constant and vigilant cultivation of our present fruits.

Dr. Van Mons, professor at Lourain, was the first to make any great discoveries in ameliorative cultivation. In 1823 his nurseries contained 2,000 seedlings of merit. His theory was that all fine fruits are artificial products. All that wild nature can produce is a healthy, vigorous tree, and a fruit sufficient to protect perfect seeds for continuing the species. The object of cultivation is to enfeeble the tree's excess of vegetation, to diminish the size of the seeds and increase the quantity of flesh or pulp. The older the tree the more likely are its seedlings to return to the wild state. While the seeds of the oldest varieties of good fruit mostly yield inferior sorts, seeds taken from recent varieties of bad fruits, and reproduced uninterruptedly for several generations will certainly produce good fruit. A most important aid in producing the desired varieties is by cross-breeding. This is effected by taking the pollen of one blossom and dusting it upon the pistil of another from which the original stamens have been removed. The development of plums and apples has been much aided by this process, and Mr. Coxe has described an apple which was a cross between a Newton pippin and a russet. It was in appearance half the one and half the other, one end tasting like a pippin, the other like a russet. After a new and choice variety of fruit has been obtained, and of which probably, there is only one tree, it may be propagated by grafting and budding. Grafting is as old as the early Roman Republic; it was also practised by the ancient Greeks. The French orchardists are most expert in it and practice it in more than 50 different ways. The proper time for grafting is in the spring, as soon as the sap stirs, which commences earliest with the cherry and plum, and ends with the apple and pear. Budding differs from a common grafting. Merely a bud, with the smallest possible quantity of the adjoining bark and wood, is inserted in the incised tissues of another tree. All stone fruits are difficult to graft, but can be budded with ease. Fruit trees are also propagated by cuttings, that is, by taking twigs from a good variety and setting them out to take root; or by layers and suckers. A layer is a cutting, part of which is sunk in the ground, while the end is not detached from the parent tree. Suckers are shoots sent up from the root and easily detachable so as to be planted.

The grape vine is almost invariably propagated by cuttings, as are gooseberries and currants. But one of the most important considerations for the fruit cultivator is the soil and its preparation. No good fruit can be produced on dry or barren soil, and fertilizing, watering, and thorough sifting of the orchard or vineyard bed is absolutely necessary for success. Almost equally important is the slope and aspect of the land to be occupied. The warding off of diseases and insect pests from growing fruit also calls for great care on the part of the fruit cultivator.

See Corn-fertilization; Distribution of Plants; Fruit-growing; Fungicide; Fungi; Economical; Grafting and Budding; Implements, Agricultural; Insecticide; Manures and Manuring, Ecology; Mulch; Plant-breeding; Pollination; Pruning; Tillage; Windbreak, and articles on the various fruits.

Consult: Bailey, 'Principles of Fruit Growing'; 'Nursery Book'; Barry, 'Fruit Garden'; Fuller, 'Propagation of Plants.'

Fruit-bats, the bats of the family *Pteropodidæ,* called also fox-bats or flying-foxes, because of their fox-like heads and faces. They compose one of the two grand subdivisions of bats, the *Megachiroptera* (see Bat), confined to the tropical parts of the Old World. These are the largest of all bats, and differ from the other bats in that they are entirely frugivorous. There are several genera, the most important being the genus *Pteropus.* The best-known species is the Indian fox-bat (*P. medius*), common in India, Ceylon and neighboring islands. As evening falls these bats fly out of the branches, where they have hung, like great black fruits, all day, and start on their nocturnal depredations, which they continue until dawn, when they return to their homes, — thousands sometimes forming a single colony, wrangling and jostling one another for the most desirable places on the limbs. Once settled they hang, head down, until day is over. They are so numerous and so destructive to crops in certain localities that they are hunted vigorously; but, even when they are shot by thousands, the numbers do not seem to be materially decreased. There are certain species that sometimes feed on flowers as well as fruit; but this is not generally the case. The Indian fruit-bat, Lyddeker says, will greedily drink palm-juice from the pots hung on the trees to collect it, and at times, individuals have been found at the foot of the trees quite helpless from intoxication.

The spread of wing is from 4 to 5 feet in the Indian and Malay species; smaller than these are the ugly-faced *Harpyias,* so named because of the supposition that they were the «harpies» of the old mythology.

Fruit-crows, the somewhat crow-like birds of that section of the South American family *Cotingidæ* called *Gymnoderinæ.* This

section contains a number of most unusually ornamented birds, such as the bill-bird, and umbrella-bird (qq.v.), and most of them have bare spaces, or wattles, about the head. They are woodland birds whose habits are little known, but they feed mainly on seeds and berries, and make large nests in trees and bushes.

Fruit-fly, any of the flies of the family *Trypetidæ*, whose eggs are laid and maggots are bred in fruit, for example, the apple-maggot (q.v., under APPLE), or in plant-stems. The Mexican orange-worm (see ORANGE INSECT-PESTS) is another well-known species, while the galls so frequently observable upon the golden-rod are the work of a third (*Trypeta solidaginis*). The maggots remain within the fruit or gall during the winter, then, if not already thrown down, creep out, drop to the ground, and transform into pupa and imago. They vary in color from buff to brownish-black, and are frequently beautifully banded or spotted. See also POMACE-FLY.

Fruit growing. Fruit growing as a distinct phase of agriculture is of comparatively recent development in America. The early settlers, who were located chiefly along the Atlantic Coast, in the Lake Region and the Mississippi Valley, found an abundance of wild fruits of many species similar to those known to them in their European homes, and in many cases superior in size, flavor, and quality, to the wild fruits of Europe. This fact encouraged them to introduce the cultivated forms and varieties of the Old World, so that as soon as regular and reliable means of communication were established with the mother countries, seeds, scions, and young trees of the choice varieties of western Europe and the Mediterranean region were secured for testing in practically all of the colonies from the Saint Lawrence Valley southward to Florida. Naturally these early introductions were made in a desultory way and the larger portion of them failed through inability of the types and varieties developed in Europe and western Asia to endure the more intense climatic conditions that prevailed in similar latitudes on the American continent east of the Rocky Mountains. The art of grafting was evidently known to some of the early colonists for as early as 1647 it is recorded that the apple was grafted on wild stocks in Virginia, where in 1686, one orchard of 2,500 apple trees is known to have existed. In 1647 Governor Stuyvesant planted on Manhattan Island a grafted tree of the Summer Bonchretien pear, said to have been imported from Holland. This tree, which is the earliest recorded grafted tree planted by the colonists, stood at what subsequently became the corner of Third avenue and Thirteenth street, New York city, until it was accidentally broken down by a dray in 1866.

The early efforts with orchard fruits were devoted chiefly to the introduction of such as would yield a supply for the family of the owner, rather than to develop a commercial industry. About the only exception to this was the apple, which was planted quite largely in many sections for cider making. This was especially true from Virginia northward, one Massachusetts village, consisting of forty families, having attained the distinction early in the 18th century of producing «near ten thousand barrels of cider.» The early efforts toward the introduction of wine-grapes are related under GRAPE CULTURE.

Bailey states that there are not less than 150 species of native North American fruits fairly well known, of which not more than 40 are of commercial importance. These cover a very wide climatic range, from the hardy plums and apples of the far north to the figs, oranges, and lemons of California, and the oranges, pineapples, mangoes, guavas, and other tropical fruits of Florida. The great diversity of soil and climate render it possible to produce in the United States, Canada, and Mexico, practically all of the important fruits and nuts known to commerce throughout the world, so that America has become in large degree independent of the Old World in the matter of fruit supply. The chief exceptions until recently have been certain sub-tropical fruits and nuts, such as oranges, lemons, dates, figs, almonds, and walnuts, but production of these has shown such rapid increase during the past few years as to largely displace the former imports of these fruits. For convenience in discussion, the various fruits have been grouped by Prof. L. H. Bailey, 'Principles of Fruit Growing' (1897), into four classes, which may be summarized as follows:

Class I.— Tree-fruits, comprising about 100 species divided into 13 sub-classes.

Class II.— Vine-fruits, comprising the grapes and passi-floris, divided into two sub-classes.

Class III.— Small-fruits, comprising about 20 species, divided into three sub-classes.

Class IV.— Herb-like fruits, comprising about 10 species, divided into four sub-classes.

While the effort to produce a home supply was evident at a very early day, the development of a large commercial fruit industry can hardly be said to date earlier than 1850. Before then plantings of orchard fruits were limited to the needs of the farmer's family or the nearby village or city, except in a few localities where apples and grapes were grown for the manufacture of cider and wine respectively. Each improvement in transportation has been followed by a marked increase in fruit planting and production, frequently at points remote from those where the product is consumed. This is most noticeable in the case of the more perishable fruits, such as the strawberry and peach. The planting of these for the supply of the cities along the Atlantic seaboard has gradually spread southward and westward until there are large shipments of these fruits each year from points as far south as Florida, and as far west as Texas. The fruits grown in the drier climate of the Pacific coast have been found to endure transportation better than those of more humid regions, and their peaches, plums, apricots, cherries, grapes, and pears, as well as the citrous fruits are marketed with little risk in eastern cities. The perfecting of the refrigerator-car service on land has played an important part in this development, and in conjunction with refrigerated compartments on ocean steamers, has resulted in the beginning of what promises to become a very important export trade in such fruits as peaches, pears, plums, and possibly some other perishable fruits that fail to endure the vicissitudes of ordinary transportation.

Types and methods.— The early efforts at commercial fruit culture in America were

1. Birdseye view of a well-cultivated peach orchard.. 2. Strawberry growing in Wisconsin.

573

FRUIT GROWING.

1 Napoleon cherry trees in California. 2. A West Virginia peach orchard.

mainly based upon European varieties, and the methods of culture were such as were followed in the Old World. The unsatisfactory behavior of a large proportion of the imported varieties gradually led to the substitution of seedlings of American origin, which, in the case of most of the important species, have proved much better adapted to American conditions. Prior to the middle of the 19th century most of the American varieties of orchard fruits that came into prominence were accidental seedlings, which were observed to yield fruit of special value, and were, therefore, named and propagated as commercial sorts by their discoverers, for examples, the Baldwin, Ben Davis, and Winesap apples, and the Catawba grape. In recent years attention has been devoted to the breeding of sorts better suited to special conditions or for specific uses, and rapid progress has been made along this line in strawberries, grapes, plums, and peaches. At first these efforts consisted chiefly of the growing of seedlings from seed of choice varieties without effort to control the male parentage, but more recently much definite work has been done in breeding through the cross-pollination of varieties possessing the characters that are desired in the offspring. Notable work in this line has been done by Munson of Texas, Burbank of California, Webber of the United States Department of Agriculture and others. The result of the tendencies above indicated has been to create a distinctive American pomology, consisting largely of Old-World species but mainly of varieties of American origin. In the case of the strawberry, the raspberry, both black and red, the blackberry, dewberry, and gooseberry, the plums of the Mississippi Valley region and the grapes grown east of the Rocky Mountains, the species as well as the varieties are largely of American origin. (Consult Bailey, 'Evolution of Our Native Fruits.')

The gradual change in varieties cultivated has been accompanied by a radical change in methods of culture. With the development and improvement of agricultural implements, hand labor has largely given way to horse-power methods so that a large acreage is now effectively managed with few hands at comparatively small cost, except during the harvesting and marketing of the crop which, with most of the fruits, is still done by hand labor. The prevention of injury by fungous diseases and injurious insects has necessitated the development of economical and effective means of combating these pests. While radically different treatment is needed for different pests, the last decade has witnessed a very general resort to the use of fungicides and insecticides (qq.v.) applied to the trees or plants in the form of sprays.

Methods of cultivation and pruning differ widely for different fruits and in different sections of the country, but in recent years there has been a marked tendency toward clean cultivation of the soil during the early part of the growing season to insure vigorous growth of wood and foliage, followed by the sowing of some leguminous or other cover crop, which is allowed to grow during fall and winter for plowing under the following spring. This practice, where pursued, aids in maintaining the proper proportion of humus in the soil, and when supplemented by applications of phosphoric acid and potash as needed, promotes a healthy and vigorous growth capable of producing normal crops of well-matured fruit. While the pruning of orchard trees to fixed and arbitrary forms is as yet little practiced in America, more attention is paid each year to pruning for specific purposes, such as the stimulation of growth, the setting of fruit buds or the reshaping of the tree or vine. In most sections the practice of heading trees low is on the increase, such trees being found to endure greater climatic extremes without injury, and the accessibility of their most remote branches greatly facilitates their treatment with sprays and the harvesting of their crops.

The necessity for shipping long distances has resulted in the development of methods of marketing fruits which differ widely from those practiced in the Old World. One of the most marked features is the almost universal use of "gift" packages. For most fruits except the cheaper and lower grades of apples and pears, chiefly used for cider making, evaporating, or canning, special light wooden packages are made of convenient size and form in which to pack the fruit for shipment. In most cases these packages go with the fruit, no effort being made to return them to the shipper or use them a second time. It is noticeably true that the highest type of grading and packing fruit for shipment is found in those regions which are remote from the consuming centers of population, and to a considerable extent the same is true of the methods of cultivation, pruning, thinning, and spraying, the heavy expense of long shipment necessitating the production of a more attractive product, which will command a price sufficiently high to leave a profit to the grower. The increasing tendency to plant large areas under single direction and management has had the effect to still further systematize the operations and render the product more uniform in size, quality, and marketability from year to year, while in certain localities, co-operative grading and packing are accomplishing similar results.

ORCHARD TREES AND PRODUCTS, CENSUS OF 1900, CROP OF 1899.

	Trees.	Bushels.
Apple	201,794,764	175,397,626
Apricot	5,010,139	2,642,126
Cherry	11,943,287	2,873,499
Peach and nectarine	99,919,428	15,433,623
Pear	17,716,184	6,625,417
Plum and prune	30,780,892	8,764,032
Unclassified orchard fruits	2,215,267	630,321
Cider	1,754,927 bbls.	
Vinegar	392,497 bbls.	
Dried and evaporated fruit	144,804,638 lbs.	
Value of orchard products	$83,751,840	

Magnitude of fruit industry.— Comprehensive and accurate statistics of fruit culture in North America are unfortunately lacking, but enough is known regarding certain fruits to indicate the large and growing importance of the fruit industry as will be noted below under the discussion of the several fruits mentioned. The Twelfth Census (1900) showed totals as above for the United States, while the known facts regarding the annual production and sale of

young trees by American nurseries indicate that orchard planting continues with little abatement.

Commercial apples.— The apple is both the most widely grown and generally liked of the fruits of North America. It is grown to a greater or less extent in every state and territory of the Union and Province of Canada. The range of the varieties of this fruit as to date of maturity is so great that with proper attention to their selection planters in many sections can have a continuous supply of this fruit from their own orchards during at least ten months of the year. Since the development of commercial cold storage (q.v.) and the improvement of railroad transportation from the South, the supply of American grown apples in wholesome condition in city markets is practically unbroken. (See APPLES; FRUITS, COLD STORAGE OF; FRUIT-TRADE.)

Pear and quince.—While the pear has never attained in America the relative importance that it holds in England, France, and Germany, it succeeds well. The varieties of best quality are chiefly of the European type (*Pyrus communis*) and several of the most important are of European origin, such as Bartlett, Flemish Beauty, Anjou, Angouleme, Clairgeau, Louise Bonne. The pear requires a somewhat richer soil and more cultural attention than the apple, and is subject to a bacterial "blight" which it is difficult to control in regions where the tree makes a strong and rapid growth, as in the South. In such regions this type is rapidly giving away to the Oriental type (*Pyrus sinensis*), the varieties of which are derived primarily from the Chinese sand pear. The most important of these are Kieffer and Le Conte — sorts of indifferent quality but thriving and producing crops under conditions where the better varieties cannot survive. Kieffer has been more largely planted in recent years outside of California than any other sort, and is largely used for canning. It is also well adapted to the export trade. The most important commercial pear districts are in western New York, western Michigan, central California, New Jersey, and the Chesapeake Peninsula. In the latter two regions the Kieffer predominates; in the others, Bartlett is the leading commercial sort. The quince is but sparingly grown in a commercial way, except in a few localities in western New York, New Jersey, Pennsylvania, Michigan, and California.

Stone-fruits.— Among the stone-fruits the peach ranks first in commercial importance, though its climatic range is narrower than that of the several types of plums. The rapid development and magnitude of the American peach industry constitute one of the striking features of our fruit culture. Although prior to 1870 commercial peach orchards were chiefly confined to New Jersey and Delaware, large and successful plantings are now found in all the warmer and moister states, so that total crop failures of this delicious fruit have become practically unknown. Single orchards of 100,000 trees are no longer rare, and in some instances more than 300,000 trees are under one management. The major portion of the crop is grown for marketing in the fresh state or for canning, except in California where large quantities are sundried in addition to these uses. The standard sorts of widest distribution are probably Early and Late Crawford, Elberta, Oldmixon, Stump, and Smock. The varieties of the Peento and South Chinese groups are grown chiefly in Florida, while the Spanish, Chinese Cling, and Persian groups, respectively, are grown to the northward, with the Chili type of the latter group as the most thoroughly tested as to winter hardiness.

The various types of plums are found under successful culture over a wider climatic range than any other tree fruit in America, but are of less commercial and economic importance than the apple or peach. The European types are considerably planted in the northern states, especially New York and Michigan, and constitute a very important feature of the fruit culture of the Pacific Coast. The yield of prunes is increasing rapidly, having averaged more than 120,000,000 pounds per annum, from 1898 to 1902 in California alone. In the colder portions of the North, especially in the Upper Mississippi Valley, hardy varieties of the native *Prunus Americana* have been developed, which are proving of great value. Among these are Wolf, Stoddard, De Soto, Wyant, etc. The Japanese varieties, now widely planted, are proving useful additions to our lists, though in some cases very susceptible to injury by the fruit rot (*Monilia fructigena*).

Cherries are widely planted as door-yard trees, but their commercial culture is comparatively limited in the eastern states. The sweet varieties are grown to some extent in western New York, but only in California and Oregon are they largely grown with profit. The leading varieties are Napoleon, grown on the Pacific Coast as Royal Ann and Black Tartarian. The sour varieties have a wider commercial range, and Early Richmond, Montmorency Ordinaire, and English Morello are the leading sorts.

Apricots are but sparingly grown outside of California, where there is a large production for drying and canning, as well as for shipment in the fresh state.

Small fruits.— The strawberry is widely and largely planted for commercial shipment, and fruit grown in the open air is obtainable in city markets from January to the middle of July. It is grown in all the northern states, and extensively for shipment in the Gulf States, South and North Carolina, Virginia, Tennessee, Arkansas, and Missouri. Varieties are transient and numerous, but all the varieties grown to any extent are of American origin.

The raspberries — red, black, and purple — blackberries, dewberries, currants, and gooseberries are grown in smaller areas, though in certain localities their culture has assumed distinct importance.

The cranberry, which, as a cultivated fruit, is distinctly an American product, is extensively grown in Massachusetts and New Jersey and somewhat in Wisconsin.

Citrous fruits.— The citrous fruits chiefly grown are the orange, including the mandarin or kid-glove type, the lemon, and the pomelo. The citron and the kumquat are now being commercially planted, the former mainly in California, the latter in Florida. The lime is also grown to some extent in the latter state. Prior to the great freeze of 1894–95, orange culture was the most important branch of horticulture in Florida, the annual yield having exceeded 5,000,000 boxes. Since then the yield

1. Dewberry field in Maryland. 2. Gathering peaches in Georgia.

has been relatively small, though showing marked increase in 1903. The yield of oranges and lemons in California has steadily increased for several years, having averaged more than 5,000,000 boxes per annum for the past five years.

Nuts.— Of the nuts grown in America only the almond, walnut, and pecan have attained much commercial importance, the two former in California, the latter throughout the Gulf States and lower Mississippi Valley. Chestnuts of European and Japanese types are being planted on a somewhat extensive scale in the Eastern States, and appear well adapted to the existing conditions. Cocoanuts are somewhat planted in southern Florida.

Tropical and sub-tropical fruits.— Of these the most important are the fig, olive, and pineapple, all of which have attained commercial prominence. The two former are more largely grown in California, the latter in Florida. The mango and avacado are now being planted in considerable areas in south Florida, and several other species, including the guavas and anonas, to a less extent. WILLIAM A. TAYLOR,

Pomologist, U. S. Department of Agriculture.

Fruit-pigeons, a group (*Trevoninæ*) of pigeons of very brilliant and often curious plumage, and frequently of large size, which are scattered from India to the South Sea islands. They spend their lives in the tops of the forest trees and feed wholly upon fruits, which are swallowed whole. There are about 180 species, chiefly of the genera *Carpophaga* and *Ptilopus.*

Fruit Trade, The American. The American fruit trade, which has now attained such proportions that it is entitled to be regarded as an important factor in our national commerce, had practically no existence one hundred years ago. At the beginning of the 19th century, for example, it is doubtful if there was a merchant in the United States who realized any considerable profit from his transactions in fruit. The extent of the trade at that time was represented by a few of the large importing houses, and their interest in this branch of the provision business was confined to the occasional receipt of a cargo of assorted fruits from some Mediterranean port, a few half-casks of dried prunes, currants, raisins, and figs, with, perhaps, some preserved citron. In fact, it was some years after the birth of the last century before even the New York grocers could see any advantage in trading in the native fruits that were frequently brought to the city by the neighboring farmers, and it was not until many years later, or at sometime about 1830, that any of the Metropolitan business men began to give any serious attention to the importation of foreign fruits.

Of course, this does not imply that foreign fruits were not imported from time to time. As early as 1804, a consignment consisting of about 30 bunches of bananas had been brought into the United States by Captain John N. Chester, of the schooner Reynard, but while, during the next 26 years, similar small lots were imported, it was not until 1830 that John Pearsall, a member of the firm of J. & T. Pearsall, decided that it would pay him to negotiate for cargoes of this fruit at regular intervals. He accordingly chartered the schooner Harriet Smith, and, within a few weeks, unloaded the first large cargo of bananas ever brought to New York. It consisted of 1,500 bunches.

The first cargo of oranges arrived at New York, in a sailing ship from Sicily, in 1832. Within a few months a cargo of lemons followed, and, within a comparatively short time, the importations of fruit from the Mediterranean ports became an established branch of our international trade. For fully 30 years these fruits from Italy, especially in the case of lemons and oranges, held full possession of the American market, and sailing ships, which were chartered expressly for that purpose, sped back and forth across the Atlantic to bring these fruits, the demand for which was constantly increasing. In fact, so eager was the competition in those days that entire shiploads were often purchased by importers and dealers before they had been a day at sea, and while the quality and condition of the goods could be nothing more than a matter of speculation.

Prior to 1865, the market for foreign fruit in this country was largely controlled by the great importing houses, most of whom purchased direct from the Italian producer. Among the houses that were most famous some half a century ago, one may mention the names of such firms as Devlin & Rose; Chamberlain, Phelps & Company; James Robinson & Company, and Lawrence, Giles & Company, all of New York; Daniel Draper & Company, and Conant & Company, of Boston; Dix & Williams, of Baltimore, and S. S. Scattergood & Company, and Isaac Jeanes & Company, of Philadelphia. In 1865, however, the Italian fruitgrowers consented to consign their fruit to the American firms, and this method of transacting business continued unchanged until about 1880, when several of the largest Italian fruit houses sent men to this country to represent their interests in the American market, since which time they have quite generally maintained their control over the importations from Sicily and the mainland, the Italian shippers feeling that it is safer to deal directly with a compatriot than indirectly with a stranger. As the result, Italy is still the largest importer of fruit in America. Spain's attempt to introduce her oranges was unsuccessful, and now, with the exception of her lemons and her Malaga and Almeria grapes, she sends but little of her product to this country.

The great changes in the conditions of the American fruit trade have all occurred since 1865. Prior to that time the importer of foreign fruit had little reason to figure upon any great local competition, but, since the close of the Civil War, the development of American resources has completely altered the situation. In the earlier days, New York, New Jersey, and Delaware were practically the only States in which small fruits were raised in any considerable quantities, but, even in such instances, there was nothing like a systematic trade in these products. If the Delaware peach crop failed, there was no other section of the country that could come

to the rescue, for California at that time was not what she is to-day, one of the most resourceful fruit-growing States in the Union.

The first consignment of fruit from California came by express to New York, in 1867. Although picked green, and brought through with as much care as possible, considering the primitive methods of shipment then in vogue, the condition of the fruit upon its arrival did not compensate for the expense involved in the experiment. Although financially a failure, however, both the shipper and the transportation company had learned something from the experience, with the result that, in November of the following year, a second shipment of pears and grapes was brought through in such good condition that the pears sold at $3.50 to $5 a box, and the grapes, which were principally Tokays, from $10 to $15 for each 40-pound crate. This fruit, which was consigned to N. R. Doe, came from California in four ventilated cars attached to a passenger train, and, although the transportation charges were heavy, the return was sufficient to prove that the experiment could be made a source of great profit. From this beginning the California overland fruit trade has grown steadily until to-day thousands of carloads of such fruits are shipped from that portion of the country every year, of which upward of 2,000 are consigned to New York alone. Including its canned fruits and nuts, the shipments from California, both by sea and rail, showed an aggregate of nearly 520,000 tons in 1900, and this amount, great as it may seem, has been exceeded every year since the last census figures were published.

The development of the Florida fruit trade dates from early in the seventies, and then, as now, oranges were the staple fruit of that State. Of far better quality than the foreign fruit, they speedily attained a degree of popularity that gave them a most important position in the market. For years, therefore, their sway was uncontested, and it was not until the California growers began to develop their orange industry so extensively that the Florida producer commenced to experience the effect of any rivalry.

One apparent result of the growth of the fruit industry of this country has been the creation of a greater demand for fruit in general, a demand which is now so great that even the foreign fruit trade has profited by it. As in the case of the California fruit, this situation is largely due to the condition of American transportation rates. These are so high that, even in the case of Florida fruit, the Sicilian shipper can box, transport, and pay all charges on his product, including the item of customs duties, and still land the fruit at New York at a smaller total expense than any of the local growers can market their output.

That the local fruit is able to hold its own, however, in spite of such handicaps, is indicated by the fact that the shipment of oranges from California and Florida each year closely approximate 9,000,000 boxes. In addition, there are the other fruits from California, the market for which is constantly widening, to say nothing of the millions of pineapples that are sent to the North from Florida every season, and the annual harvest of olives, which is not far short of $300,000 in value. At the same time our importations of fruit are still eight or nine times greater in value than our exports, nor is there many apparent indications that these figures will undergo much change. At present, as in the past, our exports are confined almost exclusively to our shipments of apples, an item in our commerce that has increased so materially that the exports which amounted to scarcely more than $25,000 in value in 1850, have grown to such an extent that they represented more than $3,500,000 in 1905. England is the greatest receiver of this product, and if her demand for apples continues to increase as it has during the past few years it will not be long before it will require no less than 1,500,000 barrels to meet the requirements of the great auction-houses of London, Liverpool, and Glasgow alone.

The wide development of the fruit trade which has been effected during the past 25 or 30 years has naturally resulted in the organization of many associations which have been planned as safeguards for those who are engaged in such commercial enterprises. To-day there are institutions of this character in all the large cities of the country, but those that are best known are the New York Fruit Exchange, which operates on principles similar to those of other great exchanges; the Fruit Buyers' Union, which aims to systematize the methods of the green-fruit import and auction business, and the National League of Commission Merchants, which purposes to obtain uniformity and integrity of method in the commission business. Through the efforts of these organizations, and the local exchanges and associations in other parts of the country, the dealers in fruit are now able to transact a business which aggregates, including both imports and exports, an amount which will exceed $25,000,000 per annum. In addition to this there is the enormous domestic product, which, while it varies from year to year, and has never been reduced to exact statistics, will undoubtedly represent a sum that is equally as great.

Fruits, Cold-storage of, the preservation of fruits, by keeping them in a refrigerator or ice-box of such a temperature as will neither freeze them nor permit the process of ripening to advance. The problem of cold-storage has at length been solved by experiments recently made (1903) by the government expert, W. H. Ragan of the Department of Agriculture, at Washington. It had been generally supposed that cold-storage fruit quickly rotted, on exposure to the ordinary atmosphere of the dwelling-house in summer or winter. It has, however, been discovered that when fruit is put up in a proper condition, and kept subject to a proper temperature, it remains uninjured by storage for some time. Thirty-two degrees is considered suitable temperature for the cold-storage of fruit. Peaches of good color, yet still hard, if fresh from the tree, have been kept in cold-storage for four weeks, and found at the conclusion of that period in fairly marketable condition. They have

maintained this condition for at least four days. It is only when they are in bad condition, imperfect and poorly colored, that they spoil on exposure, after resting in cold-storage.

In order to obtain good results the temperature of a cold-storage warehouse should be kept uniform throughout. Freshly plucked fruit is alone suitable for storage, for a delay of a few days, even of a few hours, will result in serious loss. While pears must be gathered as soon as they reach their full size on the tree, apples may best be stored when well matured and highly colored, though still hard. The storing should be made in small packages, certainly of not over 50 pounds; this is especially the case with regard to quickly fermenting fruits, such as pears and peaches. The careful ventilation of the cases, barrels or boxes, which enclose the fruit, is absolutely indispensable. Nothing is more likely to prolong the preservation of fruit in cold-storage than wrapping them individually. Double-wrappings are even better than single. The inner paper should be porous, like blank newspaper tissue, the outer may be paraffin paper.

Fry, Elizabeth Gurney, English philanthropist and prison reformer: b. Earlham, Norfolk, England, 21 May 1780; d. Ramsgate, Kent, 12 Oct. 1845. Brought up a Quaker by her family she did not adapt her mode of life to that prescribed by the more rigid and orthodox of the sect, till 1798, being then induced to do so by the preaching of William Savery, an American Friend traveling in England on a religious mission. This change was consummated by her marriage in 1800 with Joseph Fry, himself a «plain Friend.» In 1810 Mrs. Fry became an occasional preacher and thenceforward devoted herself to offices of the purest benevolence and piety. Owing to her unwearied exertions, important reforms were effected in the prison systems, not only of Great Britain, but also in those of France and Germany. See ‹Memoirs› by Tompson (1846); Corter (1853).

Fry, James Barnet, American military officer: b. Carrollton, Green County, Ill., 22 Feb. 1827; d. Newport, R. I., 11 July 1894. He was graduated at the United States Military Academy in 1847, and after serving as assistant instructor at West Point, he was assigned to the 3d Artillery, then in Mexico, where he remained till the close of the War. In 1863 he was appointed provost marshal-general of the United States, with headquarters at Washington, D. C.; and in 1864 was promoted brigadier-general. He was brevetted major-general in the regular army, 13 March 1865, for «faithful, meritorious, and distinguished services,» and after the War served in the divisions of the Pacific, the South, the Missouri, and the Atlantic, till 1881, when he was retired. He was the author of: ‹The History of Brevets›; ‹The Army under Buell.›

Fry, William Henry, American composer and journalist: b. Philadelphia August 1815; d. Santa Cruz, W. I., 21 Dec. 1864. He early showed a singular aptitude for music, and in 1835 produced four overtures which were performed by the Philharmonic Society of Philadelphia, who presented the composer with an honorary medal. He next wrote the operas of ‹Aurelia› and the ‹Bridal of Dunure.› In 1845 he brought out his opera of ‹Leonora,› an Italian version of which was performed in 1858 in New York. In 1846 Fry visited Europe as the correspondent of several American newspapers, and after his return in 1852 gave his attention to music, producing several symphonies of merit. In 1855 appeared his next work, a ‹Stabat Mater,› brought out at the New York Academy of Music. He subsequently became attached to the editorial staff of the New York *Tribune*, and attained much popularity as a public lecturer.

Frye, William Pierce, American lawyer, legislator, and statesman: b. Lewiston, Me., 2 Sept. 1831. The son of Col. John M. and Alice M. Frye. He was graduated at Bowdoin College in 1850 and after studying law in the office of William Pitt Fessenden, he began the practice of his profession at Rockland, and later at Lewiston. He was elected to the State legislature from the latter city in 1861, 1862, and 1867. In 1864 he was a presidential elector on the Lincoln ticket. After serving a term as mayor of Lewiston, he was elected attorney-general of the State, on the Republican ticket, holding the office from 1868 to 1870. He was elected to Congress from his home district in 1871, and was re-elected no less than five times.

In 1881 he resigned his seat in the House of Representatives to accept the nomination to the United States Senate, filling the vacancy caused by the resignation of James G. Blaine, who entered Garfield's cabinet as secretary of state. Senator Frye was re-elected to the Senate in 1889, 1895, and 1901. He was elected president pro tem. of the Senate in 1896, and has twice acted as permanent presiding officer of that body — after the death of Vice-President Hobart in 1899, and after the elevation of Vice-President Roosevelt to the Presidency in 1901. After the close of the Spanish-American war Senator Frye was a member of the Peace Commission in Paris. He was chairman of the Commerce Committee in the Senate and has exerted a great influence on national legislation. He has been looked upon as one of the great leaders of the Republican party, and has had much to do with framing legislation on the tariff and as regards American shipping. During the exciting days of the Spanish-American war he acted as chairman of the Senate Committee on Foreign Relations. Senator Frye was given the degree of LL.D. by Bowdoin College in 1889, and also by Bates College in 1881.

Fryer, John, American Orientalist: b. Hythe, Kent, England, 6 Aug. 1839. Educated in London, England, he has occupied several educational posts and acted as government translator in China. He was appointed Agassiz professor of Oriental Literature in the University of California in 1892. Among his writings are: ‹Educational Directory for China› (1895); ‹Translator's Vade-mecum, or Vocabulary of Scientific Terms in Chinese and English.›

Fteley, Alphonse, American civil engineer: b. Paris, France, April 1837; d. Yonkers, N. Y., 6 Aug. 1903. He was educated at the Ecole Polytechnique, Paris, and came to the United States in 1865. He was resident engineer of the Waterworks Bureau of Boston (1873–80); chief assistant city engineer of Boston (1880–4), and subsequently consulting engineer. He was also chief engineer of the New York Aqueduct Commission (1888–1900). In the last

named capacity he planned the Croton dam in 1891, and the Jerome Park reservoir in 1894.

Fu-Kien, foo-kē-ĕn', or **Fokien,** a province of China, bounded north by Che-Kiang, northwest and west by Kiang-Si, south by Kwang-Tung, and southeast by the China Sea; area, 38,500 square miles. The coast is deeply indented by bays and studded with islands, including Amoy, Hai-Tan, and others. The island of Formosa formerly belonged to the province. The interior is generally mountainous; but by cultivating not only the plains and slopes, but terracing the hillsides, often to their summits, the far greater part of the surface is turned to good account. The higher mountains are covered with trees, and the cultivated terraces sometimes number 30 to 40. The Min and its tributaries are the most important rivers. The principal products are rice, wheat, barley, tea of superior quality, silk, sugar, indigo, camphor, and tobacco. The minerals include iron and alum, which, with porcelain, various tissues, and the above products, are the chief exports. The capital is Fu-Chau. Amoy, a treaty port, and other important commercial towns are also included in the province. Pop. 25,790,556.

Fu-Shan, foo-shän', a town of China, in the province of Kwang-Tung, 21 miles southwest of Canton, on one of the branches of the delta of the Si-Kiang. It has manufactures of silk, iron and steel, etc., and carries on some trade. Pop. (1900) 200,000.

Fuà-Fusinato, foo-ä foo-sē-nä'tō, **Erminia,** Italian poet: b. Rovigo, 5 Oct. 1834; d. Rome 27 Sept. 1876. She was married to the poet Arnaldo Fusinato (q.v.) in 1856. Her spirited appeals to national sentiment in 1848 brought her widely into notice. In 1852 was published her 'Verses and Flowers.' She wrote a series of 'Stornelli,' advocating Florence as the national capital instead of Rome. Her complete poetical works, 'Versi,' were published in 1879; her 'Literary Writings' in 1883.

Fuca, Juan de, hoo-än' dā foo'kä (originally Apostolos Valerianos), Greek navigator: b. Cephalonia; d. Zante 1602. He was for many years in the Spanish naval service. In 1592, when he discovered the sea-passage separating Vancouver Island from Washington, and connecting the Pacific Ocean with the Gulf of Georgia and with Admiralty Inlet and Puget Sound, he thought he had chanced upon a connection between the Atlantic and Pacific oceans. This straight has been called after his name.

Fuca, Strait of. (See Juan de Fuca, Strait of.)

Fuchs, fooks, or **Fuchsius, Leonhard,** German botanist: b. Membdingen, Bavaria, 17 Jan. 1501; d. Tübingen, 10 May 1566. He studied the classics under Reuchlin at Ingolstadt, and was graduated Doctor of Medicine in 1524. He afterward turned his attention to botany, of which science he must be looked upon as one of the fathers. In his 'Historia Stirpium' (1542), he gave a clever description of domestic plants, alphabetically arranged, and laid the foundation of a permanent botanical nomenclature. The fuchsia (q.v.) was named after him.

Fuchsia, fū'shĭ-a or fook'sĭ-a, a genus of plants, the type of the tribe *Fuchsieæ,* natural order *Onagraceæ,* named after the botanist Leonhard Fuchs. The genus contains more than 50 known species, chiefly natives of Mexico, Peru, and Chile. Some have been found in New Zealand. The plants are shrubby or arborescent, sometimes climbing; the flowers are pendent, large, and fine, with brilliant and delicate coloring — purple, rose, and white; the calyx is four-cleft, the corolla four-petaled, the fruit four-celled. The leaves are opposite and verticillate. The flowers are both axillar and terminal, usually one flower springing from the axil, more rarely in racemes at the top of the branches. Fuchsias are much cultivated in conservatories, and are favorite house-plants throughout the United States. Some varieties are hardy enough to bear a northern climate. They are propagated with great facility from cuttings, but the berries, which are preserved and eaten in South America, rarely ripen elsewhere.

Fuchsine, fook'sĭn, an aniline dye prepared by the action of arsenic acid, stannic chloride, or other oxidizing agents upon a mixture of aniline and its homologue toluidine, which yields a mass with a bronze or coppery lustre, called rosaniline. This dissolved in water, precipitated with common salt, and the precipitate washed and crystallized from water, forms fuchsine, which in commerce receives various fancy names, as magenta, aniline or new red, roseine, rubine, etc. It is largely used for dyeing purposes, and wines and even confectionery are sometimes colored with it.

Fuchsius. See Fuchs.

Fuchs' Soluble Glass, so named after its inventor, Johann Nepomuk von Fuchs (1774–1856), who discovered the process in 1823, is a silicate of potassium, made by fusing 15 parts quartz sand, 10 of potassic carbonate, and 1 of charcoal. A similar compound is made from 15 parts sand, 8 carbonate of sodium, and 1 of charcoal. The mixture being made, is heated in a crucible until it is liquefied, care being taken that the materials do not remain too long in contact with the crucible, otherwise alumina, etc., may be dissolved, and the product alter its character. After cooling it forms a hard vitreous mass, tolerably permanent in the air, with conchoidal fracture; and varying in color, passing from pale-green into black. It is soluble in water, with alkaline reaction; the solution is not very stable, being apt to deposit silica on standing, and particularly if carbonic acid gas be absorbed. Soluble glass is employed to render wood uninflammable, and along with a solution of calcium to give stonework a waterproof coating. It is also the fixing agent in fresco coloring according to the art of stereochromy.

Fudge Family in Paris. A satire written by Thomas Moore in 1818, the under-bred English in foreign countries being the subject.

Fuego (fwā'gō) **Island.** See Fogo.

Fuel, any material which is burned for the purpose of warming buildings, generating mechanical power, or accomplishing other useful results. Fuels may be conveniently divided into three general classes: Solid fuels, comprising coal, lignite, peat, coke, charcoal, and wood; Liquid fuels, comprising petroleum, shale oils, and animal and vegetable oils; and Gaseous fuels, comprising natural gas, producer gas, water gas, coal gas, and «mixed gas.» Wood was formerly the chief and practically the only fuel that was used in considerable quantities,

save in regions where an abundant supply of peat could be had; but it has now been almost altogether displaced by coal, save in remote country districts, where the use of wood is still general. For detailed information concerning the various fuels mentioned above, the separate articles in this encyclopedia relating to them should be consulted. (See, for example, COAL; GAS; PEAT; PETROLEUM; WOOD; etc.) In the present article the subject will be discussed only in its general aspects.

In selecting a fuel, the main points to be considered are: (1) its cost; (2) the quantity of heat that is developed by its combustion; and (3) the mechanical problems that are involved in its use.

The cost of a fuel varies greatly, according to the location of the point of consumption with respect to the point of production; and it often happens that a fuel that is economical in one part of the world is too expensive for serious consideration in some other part. An illustration of this fact has already been given in the case of wood, and the same principle applies with equal force to many other fuels. Petroleum, for example, is too expensive to compete extensively with coal in most parts of the world, and yet in certain regions the case is exactly reversed, and petroleum is far the cheaper of the two. Coal was practically the only fuel in extensive use in Texas, for example, until the recent discoveries of petroleum were made in that region. Since that time, however, petroleum has proved itself a formidable rival of coal throughout the southwestern part of the United States. Much of the Russian coal is of an inferior quality, and upon the Russian railways, and on the Black and Caspian seas, petroleum fuel is now used in large quantities. The oil that is most commonly burned in these regions is known as «petroleum refuse,» and is the residuum that remains behind in the retorts, after the lighter parts of the Baku oil have been distilled off as naphtha, gasoline, kerosene, etc. In the United States the distillation of petroleum has been so far elaborated and perfected, in the effort to obtain every product that would have a marketable value, that there is comparatively little «refuse oil» available for fuel purposes; and where petroleum is used as fuel in this country, it is usually in the form of the crude oil, as it comes from the well. The total production of petroleum, in the United States, is altogether inadequate to the needs of the country in the way of fuel, and it has been estimated that the Pennsylvania Railroad would alone consume more than the entire supply, if it were to adopt petroleum to the exclusion of coal. It is therefore evident that petroleum can never replace coal to any considerable extent, however convenient and economical it may be in special cases.

The heating value of a fuel is most accurately determined by the actual combustion of a sample of the fuel, and the experimental determination of the quantity of heat that this sample yields. An approximate estimate may be had, however, by means of a formula that will be presently given.

In the direct determination of the heating value of a solid fuel like coal, a weighed quantity of the fuel is placed in a closed vessel called a calorimeter, which is surrounded by a known quantity of water. The details of the experiment vary to a considerable extent in different forms of calorimeter, but the central idea is to burn the fuel in pure oxygen gas, and determine the quantity of heat given off by observing the increase in the temperature of the water by which the calorimeter is surrounded. In some forms of the instrument the sample is burned in a stream of oxygen gas, the products of the combustion being preserved for subsequent analysis. In other forms, the combustion is effected in the presence of a fixed quantity of compressed oxygen, the vessel in which it takes place being hermetically sealed, so as to retain all the products of combustion within itself. In practically all cases the fuel is ignited, when the apparatus is in readiness, by means of a platinum wire, which is placed in contact with the sample, and heated white-hot by means of an electric current. In making a test of this kind, the sample of fuel is finely pulverized in a mortar, and the quantity used varies from 1 to 20 grains, smaller quantities being used, naturally, in the sealed calorimeters than in those in which a free current of oxygen is provided. In calorimetric work great attention must be paid to small details of manipulation, and reliable results cannot be had without a considerable amount of training and experience. The results of such tests are usually expressed, in England and the United States, by giving the number of pounds of water whose temperature would be raised by 1° F., through the complete combustion of one pound of the fuel, if the heat that is developed were all absorbed by the water. The quantity of heat that is required to raise the temperature of one pound of water by 1° F. is commonly taken as the unit of heat in work of this kind, and is known as the «British thermal unit» (abbreviated to «B. T. U.»). It is often called merely a «heat unit» (abbreviated to «H. U.»), but this practice is not to be commended, since it is quite likely to lead to confusion with the French, or metric heat unit, which is known as the «calorie,» and is defined as the quantity of heat required to raise the temperature of one kilogram of water by 1° C. (The calorie is equal to 3.968 British thermal units.)

The percentage of incombustible matter in coal varies greatly, some specimens of Pennsylvania anthracite containing as little as 2.24 per cent (Carpenter), while in certain other kinds of coal, from other localities, the proportion of ash occasionally is as high as 25 or 30 per cent. If the weight of the ash is deducted from the total weight of the coal, and the residue is called the «combustible,» good Pennsylvania anthracite or bituminous coal may be expected to develop about 14,000 B. T. U. per pound of combustible, and substantially the same figure may also be given for coke. Peat develops from 6,000 to 10,000 B. T. U. per pound, but peat invariably contains a considerable amount of moisture, and a very sensible part of the heat of combustion is absorbed in evaporating this, with a corresponding reduction in the quantity of heat that is available for useful purposes. Soft wood is said to yield more heat than hard wood, ash, beech, birch, elm, and oak averaging about 8,500 B. T. U. per pound of wood, while pine yields about 9,000 B. T. U. The various petroleum oils differ considerably in composition, and hence also in the quantity of heat that is developed upon combustion. As a general average,

it may be said that one pound of petroleum yields about 19,000 B. T. U. Natural gas also varies in composition and in fuel value, but American gas of average quality may be expected to yield about 1,000 B. T. U. per cubic foot. For other data of this sort, and for full information concerning the general subject of fuels and practical calorimetry, consult: Herman Poole, 'The Calorific Power of Fuels.' See also Kent. 'The Mechanical Engineer's Pocket-Book.'

When it is not convenient to make a direct calorimetric test of a fuel, an approximate estimate of its heating power may be had by calculation from some one of the numerous formulæ that have been proposed for this purpose, provided the chemical composition of the fuel is known. Dulong's formula is perhaps the best known, but Mahler's is simpler, and appears to give even better results. If C is the weight of carbon present in the fuel, and H is the weight of hydrogen, each being expressed as a decimal fraction of the total weight of the fuel, then (according to Mahler's simplified formula) the combustion of one pound of the fuel will generate $(20050C + 67500H - 5400)$ B. T. U. This formula works well with various coals, and it also gives fairly good results when applied to wood and to oils.

The mechanical questions that have to be considered in connection with the use of a proposed fuel can only receive brief illustrative treatment in the present article. It often happens, for example, that a considerable supply of vegetable matter is at hand, which is theoretically a possible fuel, but which cannot be utilized in practice until certain serious difficulties can be overcome. Sawdust is an example of this kind. It is often embarrassingly abundant about saw-mills, but it is almost invariably damp, and it mats together so compactly that no chimney will provide sufficient draft to draw through it the air that is necessary for combustion. This difficulty has been overcome, in practice, by the construction of special furnaces in which the air required for combustion is drawn over the top of the sawdust, which is thereby caused to burn from the top downward; the mass being turned over at frequent intervals, so that fresh surfaces may be exposed. The bagasse, or exhausted cane, of the southern States, is also burned with success by similar methods. As a final example of the overcoming of mechanical difficulties in the way of using a fuel, the pulverization of coal may be cited. In the mining of anthracite coal, a certain proportion of the product is unavoidably broken too fine for use upon ordinary grates. Special grates of various kinds have been tried, with varying degrees of success, in the effort to render this fine product available for the production of steam. Recently the attempt has been made to make use of it by pulverizing it still further, until it is in fact reduced to the form of an almost impalpable powder; the powder so obtained being blown into the furnace in the form of a spray of dust, together with the precise quantity of air requisite to ensure perfect combustion. The use of such finely pulverized fuel appears to be destined to increase; the main difficulties that are now in the way being the expense of the pulverization, and the danger of storing any considerable quantity of a combustible that is so finely subdivided that it may be regarded almost as an explosive, so far as danger from fire is concerned.

Fuero (from the Latin *forum*), a Spanish word signifying jurisdiction, law, privilege. It is applied to the various written codes and characters of particular districts, towns, etc., and signifies generally those laws, privileges, and immunities founded on usage and sanctioned by the suzerain or supreme authority. Fueros are both civil and ecclesiastical. The earliest, as well as the most universal, is the *fuero juzgo.* This name (a corruption of the Latin *forum judicum*) is given to a 13th century translation of a code of the 17th century. It contains the Gothic laws which, up till this time, gradually superseded the Roman. Each law receives the name of the Gothic sovereign by whom it was promulgated. This code has formed the foundation of Spanish law down even to modern times. The fueros of Leon, known by the name of *fueros bonos*, contain a complete constitution, civil and ecclesiastical, recognize the rights of self-taxation, and of the nobility of all subjects by birth. The constitution of free towns under these fueros is essentially republican, the king having only a right to name the corregidor, who must be confirmed by the junta of the province, an assembly elected by a very liberal suffrage. As the various monarchies became consolidated under a single head, the kings became anxious to evade or withdraw privileges which interfered with the organization of their kingdom, and after 1592 when Philip II. entered Aragon with an army hanged the grand-justiciary, whose office it was to administer the oath, and abolished the constitution, the fueros as a political institution ceased to exist, although some local and municipal privileges continued to be called by that name. In 1833 a civil war broke out in the Basque provinces, in assertion of the fueros, which were formally recognized in 1844. In 1876, however, the fueros of these northern provinces were superseded by the general laws of the kingdom.

Fuerte Ventura, fwär'-tä vĕn-too'rä, one of the Canary Islands, belonging to Spain. It has an area of 650 square miles and numerous extinct volcanoes. Its principal harbor is Cabras on the east coast. Pop. (1900) 11,662.

Fuertes, James Hillhouse, American civil and sanitary engineer: b. Ponce, Porto Rico, 10 Aug. 1863. He was graduated from Cornell University in 1883. He has constructed works for the sewerage, drainage and water supply of various cities in the United States, Canada and Brazil, and is a non-resident lecturer at Cornell. He has published 'Water and Public Health' (1897)

Fuertes, Louis Agassiz, American painter of birds: b. Ithaca, N. Y., 7 Feb. 1874. He was graduated from Cornell University in 1897. He has illustrated: 'Birding on a Broncho' (1896); 'Citizen Bird' (1897); 'Song Birds and Water Fowl' (1897), and other books.

Fugger, fook'ĕr or füg'gėr, the name of a wealthy and illustrious German family of Suabia, descended from a weaver, who originally lived in the environs of Augsburg, about 1300. They were at first successful in selling clothes, but afterward extended their dealings, and became

merchants, accumulating an immense fortune. Reaching the height of their affluence at the commencement of the 16th century, they rendered considerable services to the Emperors Charles V. and Maximilian, by making them large advances. These princes bestowed titles of nobility on the Fugger family, and they soon became connected with the best blood of Germany. Promoted to the highest dignities of the empire, they did not any the more neglect the pursuits of commerce. Their riches were always forthcoming for the improvement of their birthplace, Augsburg, where they erected some handsome monuments and founded philanthropical institutions. The best known of them are the three brothers, Ulric, James, and George; and afterward Raymond and Antony, both sons of George. Ulric received for his loans to Maximilian the courtship of Kirchberg, and the seigniory of Weissenhorn, which afterward remained in the possession of his family. He was a great encourager of learning. Antony and Raymond bore, to a great extent, the expenses of the expedition of Charles V. against Algeria, obtaining from him the permission to coin money. One day, at an interview with the emperor, Antony, as a mark of his regard and esteem, threw into the fire all the title-deeds and securities which Charles had deposited with him. Toward the close of the 18th century the family withdrew altogether from trade, confining themselves to the management of their landed estates. Count Anselm Maria of Babenhausen, of the Wellenberg line (b. 1776; d. 1821), was raised by the Emperor Francis II. to the dignity of a prince of the empire. The principality of Babenhausen was annexed to Bavaria in 1806, and Leopold Fugger Babenhausen (1827–85), grandson of the first prince, was a hereditary imperial councilor, and lord high-chancelor of Bavaria. He was succeeded by his brother Karl Ludwig Maria Fugger (b. 1829), who in 1891–3 was president of the Bavarian Reichsrat.

Fugio. See CENT.

Fugitive, in law, is a term applied to persons who having violated the laws of a State escape into a foreign territory. As one State cannot pursue criminals into the territories of another, the practice prevails among the more enlightened nations of mutually surrendering such fugitives to the justice of the injured State. This practice is founded on national comity and convenience, or on express compact. The United States recognize the obligation only when it is created by express agreement (see EXTRADITION). As between the States of the American Union, extradition is made compulsory by the Federal Constitution, Art. IV. Sec. 2, which provides that "a person charged in any State with treason, felony, or other crime, who shall fly from justice and be found in another State, shall, on demand of the executive authority of the State from which he fled, be delivered up, to be removed to the State having jurisdiction of the crime." In the several States there are statutory provisions or established usages regulating the procedure in such cases.

Fugitive-slave Laws. In the colonies and under the Confederation, fugitive slaves could only be reclaimed through intercolonial or interstate comity, and in framing the Constitution, one of the chief inducements for the South to join was a fugitive-slave clause. The mandate to deliver them up, however, was only to the States which could not be punished for refusing to comply; and as the free States recognized no obligation of comity on this point, the general government passed the first fugitive-slave law, signed by Washington 12 Feb. 1793. The oral testimony of the alleged owner was all the evidence required, and on this any magistrate, even a town justice, was ordered to surrender the alleged fugitive; $500 fine was imposed for rescue, concealment, or obstruction of arrest. This made kidnapping free blacks a pastime, and it was extensively carried on in the Border States; motions to amend the law and require more evidence were voted down. On the other hand, the Border States complained of increasing escapes, and Congress promptly passed an amendment (30 Jan. 1818), enabling a claimant to make his proof before a judge of his own State, and abolishing the habeas corpus in such cases. The Northern magistrates, however, revolted against the obligation; Pennsylvania passed a law contravening the national act and providing its own methods of reclamation, and made them incumbent on her own magistrates; a Maryland slave-seeker thereupon carried off an alleged slave by force, and on his indictment the Supreme Court decided (Prigg *v.* Pennsylvania) that the execution of Federal laws could not be imposed on State officials. Taney dissented; and on this doubt the Northern States began to pass "personal-liberty laws" to prevent their officials being so employed, or their buildings used as places of detention. This roused the South to demand an effective fugitive-slave law as the price of remaining in the Union; and that of 1850 (see COMPROMISE OF 1850), the death-knell of the Northern-Southern Whig party, was passed, placing the whole course of reclamation in Federal hands. The entire machinery of the United States, from courts to army, was made part of a grand system for this one purpose, and new officials were appointed for it; marshals were liable to $1,000 fine, plus the value of the slave, if he escaped or even was forcibly rescued, and bystanders were held guilty of treason for refusing to assist; the owner's oath was full evidence, that of the alleged fugitive was not to be received, and the habeas corpus was rendered null; obstruction, rescue, or concealment, were punishable by six months' imprisonment and $2,000 damages and fine; if the claimant "apprehended" a rescue, the marshal was to take the fugitive to the claimant's State himself before surrendering him; lastly, an affidavit and general description made in the claimant's own State was to be valid for a reclamation in any other. This atrocious act was met by more stringent personal-liberty laws, which made it hard for the alleged owner or his United States agents to find any State soil to stand on in executing the writs or holding the fugitive; and in 1859 Wisconsin openly threatened to secede if the mandates were executed on her soil. Its political result was an undreamt-of boomerang, each seizure rousing a glare of public notice and hatred, often inflamed still more by the incidents — as riot and bloodshed, the murder of her child by a mother to save it from slavery (see GARNER CASE), the prosecution for treason of two Quakers who refused to join the hunt (see CHRISTIANA CASE), the seizure of long-time free black citizens of towns, etc. The

Free-Soil party demanded its repeal; the Republican party inherited and pressed the claim; and the success of the latter in 1860 was taken by the South as notice that the next administration would repeal it.

Fugue, fūg, a musical term derived from the Latin word *fuga*, — a flight, and signifying a polyphonic composition constructed on one or more short subjects or themes, which are harmonized according to the laws of counterpoint, and introduced from time to time with various contrapuntal devices. The interest in these frequently heard themes is sustained by diminishing the interval of time at which they follow each other, and monotony is avoided by the occasional use of episodes, or passages open to free treatment. The chief elements of a fugue are: (1) the subject; (2) the counter-subject, or contrapuntal harmonization of the answer by the part which has finished the enunciation of the subject; (3) the answer; (4) episodes; (5) the stretto; and (6) the pedal point.

There are three kinds of fugue, the simple, containing one subject; the double, consisting of two subjects, occasionally intermingled and moving together, and the counter fugue, in which the subjects move in a direction contrary to each other. In all the fugues the parts *fly*, as it were, after each other, whence the name. The great masters of fugal form are Johann Sebastian Bach and Handel.

Fuller, Anna, American novelist: b. Cambridge, Mass., 9 Nov. 1853. Her works are: ‘Pratt Portraits; Sketched in a New England Suburb’ (1892); ‘A Literary Courtship’ (1893); ‘Peak and Prairie’ (1894); ‘A Venetian June’ (1896); ‘One of the Pilgrims’ (1898); ‘Katherine Day’ (1901); ‘A Bookful of Girls’ (1904).

Fuller, Arthur Buckminster, American Unitarian clergyman: b. Cambridgeport, Mass., 1822; d. at the battle of Fredericksburg, Va., 13 Dec. 1862. He was graduated from Harvard in 1843, studied in the Harvard Divinity School, and held pastorates in Manchester, N. H., and Boston and Watertown, Mass. In the Civil War he was chaplain to a Massachusetts regiment. He edited several works of his sister, Sarah Margaret Fuller d'Ossoli (q.v.).

Fuller, George, American artist: b. Deerfield, Mass., 1822; d. Boston 21 March 1884. As early as 1857 his work attracted attention, and during the last years of his life his pictures were warmly admired by many for their richness of tone and peculiar handling, though they never appealed to the popular taste. His best-known works are: ‘The Romany Girl’ (1879); ‘She was a Witch’ (1879); ‘Winifred Dysart’ (1881); ‘A Turkey Pasture in Kentucky’; ‘Fedalma’ (1884).

Fuller, Henry Blake, American author: b. Chicago, Ill., 9 Jan. 1857. He was intended for a mercantile career, but entered literature with ‘The Chevalier of Pensieri-Vani’ (1891), and ‘The Châtelaine of La Trinité’ (1892). He next wrote: ‘The Cliff Dwellers’ (1893), and ‘With the Procession’ (1895), novels of Chicago life; ‘The Puppet-Booth’ (1896), dramatic sketches; ‘From the Other Side’ (1898), short stories; ‘The Last Refuge’ (1900); ‘Under the Skylights.’

Fuller, Melville Weston, eminent American jurist and one of the chief justices of the Supreme Court of the United States. He was born in Augusta, Me., 11 Feb. 1833; graduated at Bowdoin College (A.M.) in 1853, and attended a course of lectures at the Harvard Law School (LL.D.), and was admitted to the bar in his native city in 1855. He began the practice of law, meanwhile becoming the associate editor of the ‘Age,’ a Democratic newspaper. In 1856 he was elected city attorney and president of the common council. He resigned these offices and removed to Chicago, where he established an extensive law practice.

In 1862 he became a member of the Illinois State Constitutional Convention, and in the following year was elected from Cook County to the lower house of the State legislature. He rose rapidly in State and national politics, and from 1864 to 1880 was regularly a delegate from Illinois to the Democratic national conventions. In 1876 he placed Thomas A. Hendricks in nomination and was himself seriously considered as a candidate for presidential nomination in 1880. The same year he practically retired from politics, but gained additional fame as a lawyer during the next few years. In the famous lake-front case in Chicago he was counsel for the municipality, and in the Cheney ecclesiastical case, he defended Rev. C. E. Cheney, a Protestant Episcopal clergyman, rector of Christ Church, Chicago, against an action brought by an ecclesiastic council.

In April 1888 President Cleveland appointed him chief justice of the United States Supreme Court to succeed R. M. Waite (q.v.), deceased. He was confirmed 20 July 1888, taking the oath of office 8 October. About this time Bowdoin, Harvard College, and the Northwestern University conferred degrees upon him. In the Supreme Court he soon became a prominent figure, and he was largely responsible for the expansion of Federal power, by means of the decision asserting the implied authority of the executive to protect the Federal judge on occasion when there is just reason to believe that, while in the exercise of official duties, they are exposed to personal danger. This was especially applicable to the case of one Nagle, an Arizona cowboy, who was made a United States marshal to protect the person of Chief Justice Field, and who while performing this duty, shot and killed Judge Terry, of California.

In 1899 Justice Fuller was a member of the Arbitration Commission convened at Paris for the adjustment of the Venezuela boundary question.

Fuller, Sarah Margaret. See OSSOLI, SARAH MARGARET, MARCHIONESS D'.

Fuller, Thomas, English historian and Anglican: b. Aldwinkle, Northamptonshire, June 1608; d. London 16 Aug. 1661. He was graduated from Queen's College, Cambridge. In 1630 took orders and was appointed perpetual curate of St. Benet's parish, Cambridge, and became very popular as a preacher. In 1631 he became prebend in the cathedral of Salisbury. The same year he published a poem entitled ‘David's hainous Sin, heartie Repentance, and heavie Punishment.’ He gave up his Cambridge curacy in 1633, and next year became rector of Broadwindsor, Dorsetshire. His ‘History of the Holy Ware’ appeared 1639, soon after the

MELVILLE WESTON FULLER.

CHIEF JUSTICE OF THE UNITED STATES SUPREME COURT, 1888.

publication of which he removed to London, and was chosen lecturer at the Savoy Church in the Strand. In 1642 he published his 'Holy and Profane State' (folio). In 1650 he published 'Pisgah Sight of Palestine and the Confines thereof, with the History of the Old and New Testament acted thereon' (folio), and in 1650 appeared his 'Abel Redivivus,' consisting of lives of religious reformers, martyrs, divines, etc. In 1655 he published the 'Church History of Britain, from the Birth of Jesus Christ to the Year 1648'; to which was subjoined the 'History of the University of Cambridge since the Conquest,' and the 'History of Waltham Abbey.' The year after his death was published his principal literary work, the 'Worthies of England' — a production valuable alike for the solid information it affords relative to the provincial history of the country and for the profusion of biographical anecdote and acute observation on men and manners. Consult 'Life' by Bailey (1874).

Fuller-Maitland, John Alexander, English musical critic: b. 1856. He was graduated from Trinity College, Cambridge, in 1879, and in 1889 became musical critic on the staff of the London *Times*. He contributed to Sir George Grove's 'Dictionary of Music and Musicians,' the appendix to which he edited; translated (with C. Bell 1884) Spetta's 'Johann Sebastian Bach,' wrote a standard 'Life of Robert Schumann' (1884), and further published: 'Masters of German Music' (1894); 'The Musician's Pilgrimage' (1899).

Fullerites, a religious sect near Athol, Mass., known as Fullerites or Howlandites, established 15 Sept. 1855, by Frederick T. Howland, a Quaker, of New Bedford, Mass. Among early converts was Leonard C. Fuller, the present head of the community. Their religious belief resembles somewhat that of the Adventists, but differs in the vital point that the reign of Christ, under the expected new dispensation, is to be spiritual and not personal as held by the Adventists. They believe the judgment day has already begun; the earth is not to be destroyed, but changed; they entirely renounce spiritualism. The community live chiefly upon farinaceous food; they drink principally water and sometimes herb tea. They live on the apostolic plan of having all property in common. They dress very plainly and no jewelry is worn. Sabbath is observed from 6 P.M. Friday until 6 P.M. Saturday. They own a farm of 210 acres.

Fullers' Earth, a pulverulent material formerly much used for fulling cloth and wool, but now more generally employed as a filtering material for the clarification of oils. It is not a substance of definite composition, but consists essentially of clay, mixed with sufficient finely divided silicious matter to destroy its plasticity. The production in the United States in 1902 was $98,144, chiefly from Florida. It also occurs in Georgia, Arkansas, and other States.

Fullerton, George Stuart, American professor of philosophy: b. Fathegarh, India, 18 Aug. 1859. He was graduated from the University of Pennsylvania and in 1887 he was appointed professor of philosophy in the same institution. He is the author of: 'Preliminary Report of Seybert Commission on Spiritualism' (1887); 'The Conception of the Infinite' (1887); 'A Plain Argument for God' (1889); 'The Philosophy of Spinoza' (1894); 'On Spinozistic Immortality' (1899).

Fullerton, Lady Georgiana Charlotte Gower, English novelist: b. Tixall Hall, Staffordshire, England, 23 Sept. 1812; d. Bournemouth, Hampshire, 19 Jan. 1885. She was married to Alexander George Fullerton in 1833, and followed him into the Roman Catholic Church in 1846. Her first novel, 'Ellen Middleton' (1844), was followed by 'Grantley Manor' (1847). Her later stories, after her conversion to the Catholic faith are in a mild way "stories with a purpose," the purpose being to develop the influence of religious belief on life and character; among them are: 'Lady Bird' (1852); 'Too Strange Not to be True' (1864); 'Mrs. Gerald's Niece' (1871); 'A Will and a Way' (1881). She wrote also 'The Gold-Digger, and Other Verses' (1872). See Craven, 'Life of Lady Georgiana Fullerton,' translated from the French by H. J. Coleridge (1888).

Fulling, the act of cleansing, scouring, and pressing woven woolen goods, etc., to render them stronger, firmer, and closer; called also milling, because these cloths are usually scoured by a water-mill. The principal parts of a fulling-mill are the wheel, with its trundle, which gives motion to the tree or spindle, whose teeth communicate that motion to the pestles or stampers, which fall into troughs, wherein the cloth is put, with fullers' earth, to be scoured and thickened by this process of beating it. The operation takes from 48 to 65 hours, and results usually in considerable shrinkage in length and width; it obviates the tendency to unravel and renders the threads of the cloth so firm and close as to be almost imperceptible.

Fulmar, fŭl'mar, an Arctic petrel (*Fulmarus glacialis*), which breeds on rocky coasts of the North Atlantic in enormous colonies, and comes southward in winter. It is about the size of a large duck. The head and neck are pure white; the back and long wings of a pearly gray; breast, belly, and under surface white; bill large, strong and yellow; legs and toes brownish. The young are brownish gray. In the Hebrides, and especially in St. Kilda, where these birds reside in incredible numbers, they are of great value to the people. The fulmars breed on the faces of the highest precipices, on which every grassy shelf over a few inches in extent is covered with their nests, which are slightly excavated in the turf and lined with dry grass and withered tufts of sea-pink. One egg is deposited at a time, which the cliffmen obtain by descending with ropes from the summit of the cliffs. The birds, when seized, vomit a quantity of clear amber-colored oil of a disagreeable odor, which is one of the most valuable products of St. Kilda. The old birds feed the very young with it. The fulmar feeds on animal substances, chiefly fat. It flies buoyantly and rapidly, and withstands heavy gales, skimming the surface of the water. When a whale is caught, though few of the fulmars should be present, they assemble in thousands as soon as the cutting up is commenced; hence the whalers call them "whale-birds" or "mollymauks." They follow in the greasy track of a ship, coming within a few yards of the men engaged in cutting, and devour the morsels of fat voraciously and in great quantity.

Various other large oceanic petrels are called fulmars, as the "Cape pigeon" (*Daption capensis*), giant petrel, "nelly" or "bonebreaker" (*Ossifraga gigantea*) of the Indian and Antarctic seas, and several species in the North and South Pacific. See PETREL.

Fulminates, fŭl'mĭ nāts, compounds of fulminic acid, all of which are violently explosive. The most important of these is mercuric fulminate, which is formed by dissolving 10 parts by weight of mercury in 120 parts of nitric acid (specific gravity 1.4) and, when cooled, pouring this solution into 110 parts of 95 per cent grain alcohol. At the normal temperature a reaction sets in which becomes quite turbulent, dense white fumes being given off and then red fumes, and after this, the mercuric fulminate separates out as a gray, crystalline powder. It has the formula of $HgO_2N_2C_2$, and belongs to the class of chemical substances known as oximes. Its specific gravity is 4.42. When dry, mercuric fulminate explodes violently if struck or compressed or rubbed between hard surfaces, when heated to 186° C., when touched with strong sulphuric or nitric acids, or when in contact with sparks from flint and steel or electric sparks. In all these cases the body undergoes a detonating explosion, and its principal use is to produce detonation in high explosives, though it is also used in percussion caps and primers to ignite gunpowder and other low explosives. Mercuric fulminate should be stored and transported only in the moist condition, yet even in this condition it can be exploded by the explosion of dry fulminate in contact with it. Certain amines like fulminating silver, gold, mercury and copper are frequently confounded with the fulminates because they are also explosive. The best known of these is Berthollet's fulminating silver, which was used in the bomb which killed the Czar of Russia. This body is made by treating freshly precipitated silver oxide with ammonia water. It separates out as a black, crystalline mass, which explodes on the slightest concussion when dry and may even be exploded by rubbing when moist, so that it requires the greatest caution in handling. It has been repeatedly formed accidentally in the ammoniacal silver solutions used in silvering mirrors and in the silver baths used in the wet processes of photography and has given rise to serious explosions. See EXPLOSIVES.

Fulmina'tion, a term used in chemistry to denote the sudden decomposition of a body by heat or percussion, accompanied by a flash of light and a loud report, and differs therefore but little from detonation: except that the latter refers more to the sound, and the former to the flash. See DETONATION; EXPLOSIVES; FULMINATES.

Fulminic Acid. See FULMINATES.

Fulton, Robert, American inventor: b. Little Britain, Lancaster County, Pa., 1765; d. New York 24 Feb. 1815. Early in life he manifested a taste for painting, and purposing to adopt it as a profession, went to England to study under Benjamin West. In that country, however, he became acquainted with the Duke of Bridgewater, the founder of the canal system of Great Britain, who induced Fulton to abandon art, and take to the study of mechanical science. This nobleman was at the time engaged in a scheme of steam navigation, which he imparted to Fulton. The latter visiting Birmingham was brought into communication with the celebrated James Watt, who had just succeeded in his great improvement of the steam-engine, with the construction of which Fulton made himself thoroughly familiar during his stay. About this time he invented a machine for spinning flax, and another for making ropes, for which he obtained patents in England. In 1796 he published a 'Treatise on the Improvement of Canal Navigation.' From 1797 to 1804 he resided in Paris with Joel Barlow, the American representative at the French court. During this period he invented a submarine or plunging boat, called a "torpedo," designed to be used in naval warfare. He invited the attention of the French government to his invention, and Bonaparte, then first consul, appointed Volney, La Place, and Monge as a commission to examine it. Several experiments were made in 1801 in the harbor of Brest. He could easily descend to any depth, or rise to the surface; and where there was no strong current, the boat was quite obedient to her helm while under water. On one occasion, he remained in the torpedo several feet below the surface for more than four hours; but the motion of the boat while submerged was very slow, and it was clearly unequal to the stemming of a strong current. The French government declined to patronize the project, and Fulton accepted an invitation from the English ministry, who also appointed a commission to test the merits of his torpedo. He appears, however, to have received but little encouragement, and in 1806 returned to the United States. Having been supplied with the necessary funds by Robert Livingston (q.v.), who had been American ambassador at Paris, Fulton had the satisfaction of proving, in 1807, that steam could be applied to the propulsion of vessels with entire success. His achievement excited universal admiration, and from that time steamboats were rapidly multiplied on the waters of the United States. His first steamboat, called the Clermont (of 140 feet keel and 16½ feet beam), made a progress on the Hudson of five miles an hour. His second large boat on the Hudson was the Car of Neptune, and was built in 1807. He afterward built other steam vessels, one of them a frigate, which bore his name. His reputation became established, and his fortune was rapidly increasing, when his patent for steam vessels was disputed, and his opponents were in a considerable degree successful. Though an amiable, social, and liberal man, the anxiety and fretfulness occasioned by the lawsuits about his patent rights, together with his enthusiasm, which led him to expose himself too much while directing his workmen, impaired his constitution, and he died at the early age of 49. He was buried in Trinity churchyard, New York, and in 1901 a monument to his memory was placed there by the American Society of Mechanical Engineers. His name is perpetuated in the immediate locality by Fulton Street, Fulton Market and Fulton Ferry. Consult: Colden, 'Life of Fulton' (1817); Preble, 'History of Steam Navigation' (1883).

Fulton, Ill., city in Whiteside County, on the Mississippi River, and on the Chicago, M. & St. P., the Chicago, B. & N. and the Chicago & N. W. R.R.'s; 36 miles northeast of Rock

ROBERT FULTON.

Island. The Northwestern College of Illinois was opened here in 1865, and other prominent educational institutions are located in this vicinity. There are extensive lumber manufactories, clay-mills, sewer-pipe works, stove and metal foundries, and there is a large trade here in grain, lumber, and produce. The municipality is governed by a mayor and council elected every two years by popular vote. Pop. (1900) 2,685.

Fulton, Mo., city and county-seat of Callaway County, on the Chicago & A. R.R., 125 miles west of St. Louis. Here are located the State Institution for the Deaf and Dumb, State Lunatic Asylum No. 1, Westminster College (Presbyterian), founded 1852; the Woods College of the Christian Church of Missouri, and the Synodical College and Conservatory of Music. Fulton is noted for its fire-brick and pottery works, the city having an extensive supply of coal and fire-clay. The town was settled in 1821, and was incorporated as a city in 1859. The charter has never been changed since that date. The mayor and council are elected annually. The city owns and operates its electric light and water plants. Pop. (1900) 4,883.

Fulton, N. Y., city in Oswego County, on the Oswego River and the Oswego Canal, and on the New York C., New York, O. & W., and Delaware & L. R.R.'s, 25 miles northwest of Syracuse. It has a public library, city hall, opera house and other public buildings. It is the centre of the cheese trade of northern New York, and there are manufactures here of paper, woolen goods, flour, fire-arms, tools, water-motors, cutlery, paper-mill machinery, condensed milk, canned goods, etc. Fulton was settled in 1791 and was originally incorporated as a village in 1835. The villages of Fulton and Oswego Falls, with an aggregate population of 8,206, were consolidated and chartered as a city in April 1902. A mayor and common council govern the city, being elected every two years by popular vote. The municipality owns and operates the waterworks.

Fulvia, fŭl'vĭ-a, Roman matron: d. about 40 B.C. After being twice married she became the wife of Mark Antony. Antony divorced her to marry Cleopatra, upon which she attempted to persuade Augustus to take up arms against her husband. When this scheme did not succeed she retired into the East, where Antony received her with great coldness. This broke her heart, and she soon after died.

Fumiga'tion, an attempt at disinfection by gaseous agents. Fumigation is probably a very unsatisfactory mode of bringing about disinfection. The agents that are used most effectively are chlorine gas, sulphur dioxide, and formaldehyde. It has been distinctly demonstrated that chlorine gas as a disinfecting agent is untrustworthy, and that its application is attended with many disadvantages. Sulphur dioxide, in the absence of moisture, gives practically no results, and even when aqueous vapor is generated in a room previous to the use of the gas its bactericidal action is very slight. Moreover, sulphur dioxide in the presence of moisture in the air tarnishes brass and silver, gilt frames, etc., and corrodes fabrics and other stuffs. It is not a satisfactory disinfectant. Formaldehyde gas has been used since 1890 for fumigation. The vapor is extremely pungent, and it has a strong affinity for all organic substances. Its practical value as a disinfectant has been demonstrated to be above that of any other gaseous substance. It cannot, however, be said to give absolute results, and although its power of penetration is greater than in that of any of the others mentioned it is still only a surface disinfectant. The interior of a heap of clothing, for instance, if exposed to the gas, is not affected at all by it. Formaldehyde gas as a fumigant is not sufficiently strong to kill many household pests. This casts suspicion on its value as a room disinfectant. Moreover, it is very costly. In general it may be gathered that gaseous disinfection by fumigants is somewhat of a farce; and although formaldehyde gas approaches more closely the requirements of the ideal, it is far from being perfect. The best disinfectant for rooms is unquestionably sunlight. Short of this, thorough cleansing, rubbing down the walls, etc., should be carried out. As noted in the article on disinfection, it is the effort of hygienists to particularize on the type of disease agents which they desire to eradicate. The general modes of disinfection heretofore much in vogue were largely founded on a lack of knowledge of what the infecting agents have been. See BACTERICIDE; DISINFECTANTS.

Fu'mitory («smoke of the earth»), a name commonly given to species of the genus *Fumaria.* It is a native European weed which has been naturalized in America. The climbing fumitory or mountain-fringe of the United States grows well under cultivation. To the family *Fumariaceæ* belongs the genus *Corydalis,* found throughout most of the north temperate zone.

Funchal, foon-shäl, Madeira, the capital and seaport of the island in the centre of a large bay on the south coast of Madeira. It is irregularly built; the streets are narrow, winding, ill-paved, and dirty. An old castle, which commands the roads, stands on the top of a steep, black rock, called Loo Rock, surrounded by the sea at high water. The entire produce of the island, consisting mostly of wine and fruit, is exported from Funchal. Pop. (1901) 19,600, among whom are many English, French, Portuguese, and mulatto and negro freedmen. See MADEIRA.

Funck-Brentano, funk brōn-tä-nō, **Théophile,** French philosophical and critical writer: b. Luxembourg 20 Aug. 1830. He became professor at the School of Political Sciences in Paris in 1873. His thorough studies in law and medicine have imparted to his philosophical writings an exactitude of thought and inspired a special stress on method, very apparent in such works of his as: 'New Thoughts and Maxims' (1858); 'Exact Thought in Philosophy' (1869); 'Greek Sophists and Contemporary English Sophists' (1879); and others. As a critic he is esteemed for the happy presentation and careful elaboration of his thought.

Function, (1) In biology, the action proper to tissues, organs, or groups of organs in plant and animal life. The function of respiration is the joint action of lungs and skin; digestion is a very compound function, to which organs and groups of organs contribute. The actions are capable of being grouped in subordination to three leading phenomena of every liv-

ing thing — namely, sustentation, reproduction, and relation. To the first belong digestion and all the other functions which contribute to the vegetative life; the processes of the second are, as examples of cell transformation, so far identical with those of the other two, but the results are different; the cell changes of the nervous system which regulates the relations of living things, are again identical with those of the other two sets of phenomena. Functional diseases are those due to organs perfect in structure but not performing their functions properly; as opposed to organic or structural diseases, due to defect of structure.

Organs often have more than one function — a *primary*, or that for which it is principally intended, and a secondary, some subsidiary purpose which it performs. It sometimes happens that important changes take place in the course of the evolution of a type, or the development of an individual, whereby the primary function disappears and some secondary use becomes preeminent or exclusive. Thus "a brilliant speculation," says Carpenter, "has indicated pairs of tracheal gills on the meso- and metathorax as the possible origin of insect wings. The primeval insects forsook, so it is thought, the water for the land; and the plates, becoming useless for breathing, were enlarged and finally changed into organs of flight." Another strong and familiar example is the case so often presented among crustaceans where the mouth parts are largely structures ("foot-jaws") originally ambulatory, but now entirely devoted to the seizing and mastication of food. Change of function results in change of structure.

(2) In mathematics, one quantity is said to be a function of another, or of several others, when its value depends on those of the latter. Thus the area of a triangle is a function of its three sides, and $y = a + bx + cx^2$ is a function of a, b, c, and x. Functions receive distinctive names according to the nature of the dependence above referred to. Thus the function above written is said to be an algebraical function of x, since y is obtainable from x by the performance of a limited and definite number of algebraical operations. Log x, sin x, a^x, on the other hand, are said to be transcendental functions of x, and for obvious reasons receive the distinctive names of logarithmic, trigonometrical, and exponential functions. See COMPLEX VARIABLE.

Fundamental Note, Tone, or **Bass,** (1) The lowest or gravest note that a string or pipe sounds in generating a series of harmonics. The fundamental note of a stretched string is sounded when the string vibrates as a whole. The fundamental note of an open organ-pipe is sounded when there is one node at the middle of the pipe. In a closed organ-pipe the closed end or stopper acts as the node when sounding the fundamental note.

(2) The fundamental note also signifies the root of a chord, irrespective of the inversions of the chord; thus in the common chord of C, C E G, C is the fundamental note and remains so in the inversions E G C, G C E, E and G being called the bass notes.

Fundamental Units is the term employed in physics for units which constitute the foundation of calculations with regard to other quantities; units used for measuring others. Fundamental units are three, namely, a definite length, a definite mass, and a definite interval of time. For example, in the decimal system, the centimetre, gram, and mean solar second.

Funded Debt. See DEBT, NATIONAL.

Funding, in finance, the conversion of floating debt into an interest-bearing obligation with a definite period, on which bonds can be issued. One such operation is of special interest in United States history, as part of the operations by which Hamilton, as leader of the Federalists (q.v.), and then secretary of the treasury, succeeded in setting the government on a firm foundation. The Act of 4 Aug. 1790 funded not only the foreign and domestic debt in full, but the State debts incurred in carrying on the Revolutionary War; the bonds were at 6 per cent, but those for the domestic debt did not bear interest till 1800.

Funds, Public. See DEBT, NATIONAL.

Fundy, Bay of, a huge arm of the Atlantic Ocean extending into the land between New Brunswick and Nova Scotia, and the State of Maine, and terminating in two smaller bays, Chignecto Bay and the Basin of Minas. Its length up to Chignecto Bay is 140 miles, and its extreme breadth 45 miles. It is noted for its high tides, which are influenced by the Gulf Stream, and rise about 30 feet at St. John and 60 feet at the head of Chignecto Bay, rushing into the latter with remarkable force. At Bay Verte, 14 miles distant, the tide rises little more than 4 or 5 feet. Along its northwest side the Bay of Fundy receives the St. John, the largest river in New Brunswick, and also the St. Croix. The tides in the Fundy are perilous to navigation and produce dangerous bores, especially in the upper reaches of the Bay. At low tide there is a long expanse of mud flats, at times over 2 miles in length, and the inreaching estuaries are completely drained. At the entrance to the Bay of Fundy are the Grand Manan and other islands. See TIDES.

Fü'nen, an island of the Danish archipelago, separated from Jütland by the strait called Little Belt; area 1,123 square miles; pop. (1901) 279,501. Its shores are deeply indented; its interior is undulating, and there are numerous lakes, streams, and marshes. The largest stream is the Odense, 36 miles long. It trades principally with Sweden and Norway. It forms with other islands a province of Denmark (q.v.). Chief towns: Odense, the capital, Svendborg, and Nyborg.

Funeral Rites, the last religious and ceremonial tribute of friendship and love paid to the remains of the dead. Among the Hindus the corpse is perfumed and adorned with flowers; it is then burned; after many ceremonies the bones are deposited in a casket and buried, but afterward disinterred and thrown into the Ganges. A second series of obsequies commences after the period of mourning has expired, and this is followed by commemorative rites. The voluntary immolation (*suttee*) of the widow of the deceased, now abolished, was the most remarkable part of the ceremony. The Mohammedans bury their dead. The interment takes place as soon as possible, in obedience to the command of the Prophet: "Make haste to bury the dead, that, if he have done well, he may go forthwith into blessedness; if evil, into hell-fire." No signs of excessive grief, no tears nor lamenta-

tions, are allowed, as it is the duty of a good Mussulman to acquiesce without a murmur in the will of God. On arriving at the burial place the body is committed to the earth with the face turned toward Mecca. Monuments are forbidden by the law, but they are constantly erected. The Egyptians, it is well known, embalmed their dead. Among the Jews the next of kin closed the eyes of the deceased; the corpse was then washed, and, in the case of persons of some consequence at any rate, laid for a time in spices or anointed with spices, swathed in linen bandages, and deposited in the tomb. The mourning customs of the Jews may be collected from various passages of the Scriptures. They went bareheaded and barefoot, covered their mouths and kept silence, put on sackcloth and sat in ashes; funeral songs were sung by persons hired for the purpose. Splendid monuments were sometimes hewn out of the solid rock, with numerous niches: as each niche was filled, its entrance was stopped up by a large stone rolled against it. In the religious creed of the Greeks and Romans sepulture was an act of piety to the dead; without it the spirit had to wander 100 years on the banks of the gloomy Styx. The last breath was generally caught by a near relative, who opened his mouth to receive it; the body was washed and crowned with flowers, a cake of flour and honey placed in the hand, as a bribe for Cerberus, and an obolus in the mouth, as a fee for Charon. Interment and burning were practised indifferently. In interment the body was placed with the face upward and the head toward the west. In burning the pile varied in form and material: it was lighted by the nearest relative; perfumes and wine were poured on it, and the richest clothes of the dead were burned with him. The ashes were then collected and deposited in an urn. This description applies to the Greeks and Romans, whose rites were nearly identical.

In the Roman Catholic Church the body is washed immediately after death, a crucifix is placed in the hands, and a vessel of holy-water at the feet, with which the visitants sprinkle it. The Ritual prescribes that the corpse be borne in procession from the house in which it lies to the church, attended by the parish priest with acolytes and servitors all in cassock and surplice, and one of them bearing the processional cross in the van. Before the procession moves, the priest first sprinkles the coffin with holy-water and recites the *De Profundis* and the *Miserere* while the procession is in movement. Taken into the church, the coffin is laid on trestles in the middle of the nave, the feet to the east or the sanctuary, if the deceased was a layman, the head to the sanctuary if he was a priest; lighted candles surround the coffin. Then follows the Office for the Dead, and after that the Mass for the Dead. After the Mass the priest, attended by the acolytes, pronounces the Absolution and certain prayers, meanwhile sprinkling the coffin with holy-water and fumigating it with frankincense. The procession is now reformed and the body borne to the place of burial. There the *Benedictus* is sung or recited, followed by the Antiphon, *Ego sum resurrectio et vita* ("I am the resurrection and the life"); the corpse is again sprinkled, a final prayer is pronounced, and the body is laid in the grave or tomb. In the funerals of children, the vestments of the clergy are white instead of black, joyous psalms are chanted or recited, there are antiphons of praise and thanksgiving instead of petitions for mercy and forgiveness; and the church bell is not tolled.

In the Greek Church there are distinct services for laymen, monks, and priests severally. The officiant holds a short service at the house of the defunct; service is held at the church, to which the body has been brought, and then at the grave, where the priest takes a shovel and sprinkles dust cross-wise on the body. Finally, before the grave is closed, he casts wax or ashes from his censer upon the coffin. The English Church, followed very closely by the Protestant Episcopal Church in the United States, uses the order for the Burial of the Dead in the Book of Common Prayer. It is a stately and somewhat elaborate service, which is frequently used in part by other Protestant bodies. The first section of the service is recited in church, to which the body has been brought, or at the house of the defunct. It consists of anthem, psalms and a lesson. The second section, sometimes called the committal, is recited at the grave, where dust is scattered on the coffin as it has been lowered.

Fungi, fŭn'jī (singular *Fungus,* Latin name for mushroom), the general name applied to a multitude of lower plants of quite diverse structure, but which agree in not containing chlorophyll, the green coloring matter of the vegetable kingdom. Formerly the fungi were regarded as constituting a natural group (class or order) of plants, but are now recognized by modern botanists as belonging to many natural groups of plants.

The peculiarities of fungi are physiological; they result from their food habits, and are not primarily structural and of profound significance. When we enumerate the physiological changes involved in the change of a plant from an independent life to one of parasitism or saprophytism, we have considered all of the essential differences between the fungi and the green plants from which they have been derived. We may say then, that a fungus is a lower plant which has suffered certain physiological changes on account of the fact that it has become parasitic or saprophytic.

Before going farther it is necessary to define certain terms which must be used in any discussion of the fungi. A plant is a *parasite* when it lives upon or in another living plant, absorbing food from it, and living at its expense. The mere fact of growing upon another plant does not make the first parasitic, for there are many small plants which merely find lodgment upon larger species, not, however, absorbing anything from the plants on which they are lodged. When it is necessary to distinguish such plants, they are called *epiphytes.* In the case of parasites the plant upon which they live is spoken of as the *host.* When a plant lives upon a plant which is no longer living, it is called a *saprophyte.* Thus the toadstools which grow so freely on manure and other decaying vegetable matter are saprophytes. It is sometimes necessary to have a term to apply to plants which are neither parasitic nor saprophytic, and then we use the word *holophyte.* Thus all common green plants are holophytes. When it is desired to contrast holophytes with

both parasites and saprophytes, we can use the term *hysterophyte* for the parasitic and saprophytic plants.

Applying the terms we have now defined, we may say that all fungi are hysterophytes, some living parasitically upon their hosts, others living saprophytically.

All holophytes are green in color, and the significance of this is purely physiological. Green plants absorb the gas carbon dioxide, and in green cells this is combined with some of the elements in the ever-present moisture of the plant into a chemical compound allied to starch and sugar, and characterized by consisting of nearly equal amounts of carbon and oxygen, combined with nearly double the amount of hydrogen.

Such compounds are known as carbohydrates and they are made by all holophytes, and then used in the processes of assimilation and growth. It has been demonstrated that plants which are not green cannot make the carbohydrates, and since all plants need these compounds for building up their tissues, it follows that colorless plants must obtain them by taking them from living or dead green plants. Last, it should be borne in mind that even green plants cannot make the carbohydrates in darkness. For this work they need light and in fact the greatest importance of light to a plant is in connection with this process of making carbohydrates. Accordingly plants which are not green, and which as a consequence do not make carbohydrates, often grow in darkness or in feeble light. This is quite characteristic of the fungi, great numbers of which grow as well in darkness as in light, or in some cases grow even much better in the darkness than they do in the light.

The fungi are very numerous, some recent estimates placing the number of species as high as 250,000, of which not more than one third have as yet been described. They occur wherever there is organic matter of any kind upon which they can subsist. Wherever there are living plants or animals there are fungi which obtain food either from the living cells of their hosts, or the dead and cast-off cells and tissues. Some species occur in the lower layers of the air, in all exposed waters, and in the soil. They are the most numerous of living things when we consider individuals alone. They range in size from extremely small to many centimetres in length. The smallest are far too minute to be seen by the naked eye, some being visible only by the aid of the most powerful microscopes. Of some of the smallest species it would require 25,000 to 30,000 placed side by side to measure one inch. On the other hand there are toadstools a foot or so in height and diameter, and puff-balls two to three feet in diameter have been recorded.

The fungi as thus described are found in three of the grand divisions (branches) of the vegetable kingdom.

Branch Protophyta. The Protophytes.— Here are gathered a thousand or so species of microscopic aquatic plants in which the cells have a very low organization. No distinct nucleus is present, and the coloring matter in the typical plants pervades the whole cell, and is of a bluish or brownish-green color instead of a bright green as in higher plants. They reproduce by simple fission, and by the production of spores. There is no hint of any sexual reproductive process. They occur in ponds, pools and streams, to which they give a greenish color by their great numbers. In decaying they usually give off a fetid odor.

While the typical Protophytes are greenish — and are known as green slimes — many have become parasitic or saprophytic, and have lost their green color. These colorless species are known as Bacteria, and are the lowest of the fungi.

Bacteria (Fig. 1) are then to be regarded as colorless green slimes, their lack of color being due to their parasitic or saprophytic habits. Some species are minute rounded cells of remarkable minuteness. To these the generic name *Micrococcus* has been given, and many species have been recognized by botanists.

FIG. 1.— Bacteria. A, *Streptococcus pyogenes;* B, *Micrococcus tetragenus;* C D, *Sarcina lutea.* All highly magnified.

Other genera with spherical cells are *Streptococcus, Staphylococcus, Sarcina*, etc. Other bacteria consist of cylindrical cells which tend to adhere end to end in filaments or rods. In the genera *Bacillus* and *Bacterium* the rods are straight or little curved, and short or of moderate length, while in *Vibrio* and *Spirillum* the rods are more or less spirally curved. In still other genera, as *Crenothrix, Leptothrix*, etc., the rods are elongated. See BACTERIA.

Branch Phycophyta. The Phycophytes.—These plants, of which there are probably nearly 10,000 species, may very properly be called the seaweeds, since they are typically aquatic, living in the salt and fresh waters of the earth. Typically they are bright green, and the cells of which they are composed have well-formed nuclei. However, the chlorophyll is confined to definite portions of the protoplasm, and is not diffused throughout the cell. Some of the lower species are spherical, rounded cells, but for the most part they consist of filaments of cylindrical cells, or in some instances they are masses of cells constituting leafy-stemmed plants. They reproduce by fission as in the Protophytes, but in addition all, or nearly all, Phycophytes reproduce sexually also. In the simplest cases of sexuality, two equal and similar cells detached from older plants fuse into a new and larger cell, and then this new cell grows into a new plant. Sometimes the new cell becomes covered with a

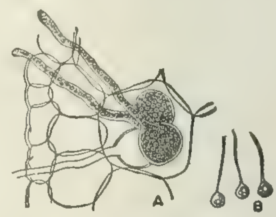


FIG. 2.— A, *Olpidium brassicæ*, one of the simplest of the fungi (*Synchytriaceæ*), parasitic in cells of a crucifer; B, three zoospores. Highly magnified.

thick wall, and for a time ceases activity as a «resting spore,» before it develops into a new plant.

While most Phycophytes are green plants, several hundred species have become parasitic or saprophytic in habit (Figs. 2 and 3) and have therefore lost their color, and become fungi. Among these are the following families, namely:

FIG. 4

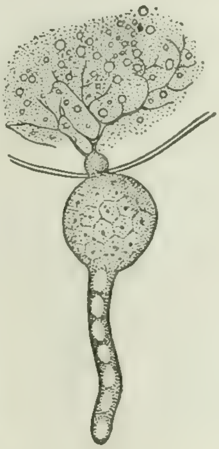


FIG. 3

FIG. 3.— *Rhizidiomyces apophysatus*, another of the lower fungi (*Chytridiaceæ*); the root-like organs are parasitic in a cell of a water mould. Highly magnified.

FIG. 4.— *Saprolegnia thureti;* A, fly with attacking filaments; B, end of a filament forming zoospores. C, zoospores escaping. A, natural size; B and C, highly magnified.

Water Moulds (*Saprolegniaceæ*) which are minute filamentous, colorless plants living in the water on living and dead plants and animals. (Fig 4.) Each plant is a more or less branched thread, some portion of which penetrates the host and thus obtains food, while the other part is external and bears the reproductive organs. The filaments are cylindrical, and are peculiar in having few cross partitions. They are to be regarded as composed of many cells which have not separated themselves by partitions. The nuclei are numerous, and very small.

The more common mode of reproduction is as follows: A terminal portion of a branch forms a partition at some distance from the extremity and the protoplasm in this segment becomes denser, and a little later divides into a great number of small cells, each of which remains naked (that is, no cell wall is formed around it), and soon escapes by a rupture of the end of the segment. (Fig. 4.) These escaped cells are known as zoospores, since they have a very active swimming motion, very like that of some of the lower microscopic animals. The similarity to the lower animals is shown still more by the identity in their locomotive organs, which consists of one or two slender protoplasmic whips (cilia) by whose rapid lashing the zoospores are propelled. After a short period of activity they come to rest, when they cover

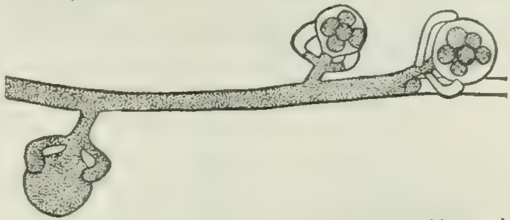


FIG. 5.— *Achlya racemosa*, showing antherids and oögones. Highly magnified.

themselves with a cell wall, and begin to elongate into a filament like that of the plant from which they came. Reproduction by means of zoospores is very rapid, since they are formed in such great numbers when conditions are favorable.

The sexual organs, which are rather rarely formed, consist first of an enlarged and rounded end segment in which the protoplasm is quite dense. From the sides of the branch below the end segment (or from elsewhere on the body of the plant) slender branches grow up and in turn their ends become cut off by cross partitions. (Fig. 5.) The first end segments (the rounded ones) are oögones, or in plainer words they are egg-organs, and in them one or more eggs are produced. The second segments (slender) are male organs called antherids, and the protoplasm they contain has the function of the spermatozoids of many plants (and animals). At the proper time the antherids puncture the egg-organs, and by the inflow of the contents of the former the eggs are fertilized. Later these eggs may germinate and produce new plants like those on which they were borne.

Downy Mildews (*Peronosporaceæ*) are much like the water moulds, but instead of being aquatic, they live in the tissues of land plants. Like the water moulds they are composed of branching, non-septate filaments. The main body of the plant grows in the intercellular spaces of the host, where there is nearly as much moisture as under aquatic conditions. (Fig. 6.)

FIG. 6.— Portion of a filament of *Albugo candida*, with its haustoria penetrating host cells. Highly magnified.

From this internal part of the plant short branches grow out into the air, and these become swollen terminally into rounded segments, which are in fact short zoosporangia. Instead of forming zoospores at once, they first fall off and then those that fall into water develop zoospores,

much as in the water moulds. As these structures are very minute, a droplet on a leaf is large enough for the germination of hundreds of the detached zoosporangia. Here again, the zoospores, after coming to rest, develop into new plants, which at once penetrate the host. In some species the zoosporangia grow at once into a filament, without forming zoospores.

The sexual organs of downy mildews are much like those of water moulds, the differences being quite immaterial for the present discussion. (Fig. 7.)

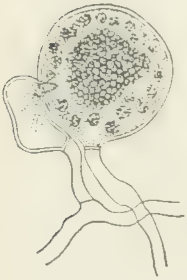


Fig. 7

Fig. 8

Fig. 7.— *Peronospora alsinearum*, showing antherid penetrating the egg-cell. Highly magnified.
Fig. 8.— *Mucor stolonifer*. Highly magnified.

It is evident from a comparison of the structure and reproductive organs of water moulds and downy mildews, that the latter are derived from the former. Just as the water moulds have been derived from the green plants of the green felt family (*Vaucheriaceæ*) by the adoption of parasitic and saprophytic habits, so by the change from strictly aquatic conditions to those found in the intercellular spaces of land plants, water moulds have been changed to downy mildews. Every difference between the two families may be accounted for by this difference in the environment of the plants.

Black Moulds (*Mucoraceæ*) show an additional modification of the water mould type. They are non-aquatic, mostly saprophytes, a few only being parasites. They live for the most part on dead organic matter, animal or vegetable, which is still moist, and but few species can live in the water. The commonest species live on the starchy and sugary substances in pantries, cellars, and other places where these substances are found in the presence of sufficient moisture. Organic substances which are dry are not attacked by black moulds.

Each black mould plant is a branching tubular filament, which has few cross partitions. One part of the plant usually grows in the substance of the organic matter, and another grows upward into the air. (Fig. 8.) The former absorbs food matter, while the latter bears reproductive organs, as in the water moulds. The ends of the aërial branches enlarge as in the two preceding families, but instead of forming zoospores, the protoplasm in the terminal segments forms many small spores, each covered with a cell wall. These spores are the homologues of the zoospores in previous families, but as the plants are not aquatic, these zoospores have ceased to be aquatic also. With a good cell wall to protect their protoplasm, they may be blown about in the air without drying up. It is in this way, in fact, that black moulds are propagated, the air currents carrying the spores sometimes for long distances, and when they fall upon organic matter under favorable conditions they quickly give rise to a new crop of mould plants. On the filaments which penetrate the nutrient substance, or grow over its surface, are to be found (rarely, however, in the common species) sexual organs somewhat resembling those of the two preceding families. (Fig. 9.)

Insect Fungi (*Entomophthoraceæ*) are somewhat similar to black moulds, but are parasitic in the body tissues of insects, and accordingly show considerable structural modifications. (See below.) Fig. 10.

Branch Carpophyta. The Carpophytes.— The plants which constitute this immense group are of much higher structure than those in the two preceding branches. They are still typically aquatic, and so are seaweeds, but this name is not as commonly applied to them as to the Phycophytes. The typical species are green plants, but in one group (the red seaweeds) the chlorophyll is hidden by a red or purple coloring matter. The plant-body is usually composed of an axis on which are symmetrically arranged branches or leaves. The lower end of the axis is supplied with root-like organs by which it is attached to the soil or other support, and the plant commonly stands upright. Some species show a wonderful beauty of form and color, and on this account are greatly prized by amateur botanists, who collect and preserve them under the name of sea mosses.

All Carpophytes reproduce by two common methods. In the first, certain end cells separate from special branches, and float away to germinate and grow directly into plants like those from which they came. In the second method of reproduction an egg-organ, much like that of

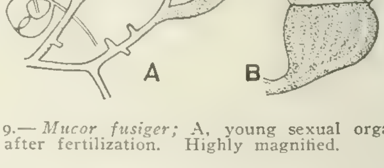


Fig. 9.— *Mucor fusiger;* A, young sexual organs; B, after fertilization. Highly magnified.

the Phycophytes, is fertilized by spermatozoids from an antherid which, again, does not differ in any essential respect from that of the Phycophytes. However, the result of the fertilization is the formation of a more or less compound body which the botanist recognizes as a primitive kind of «fruit.» Hence, the aquatic Carpophytes are sometimes known as «Fruit Tangles.» In these fruits are spores, and these on escaping and germinating give rise to new plants.

POISONOUS FUNGI.

1. Golden Cantarelle (Cantharellus aurantiacus).
2. Puffball (Scleroderma aurantiacum).
3. Green Toadstool (Russula furcata).
4. Devil's Toadstool (Russula emetica).
5. Poisonous Toadstool (Lactarius terminosus).
6. Bulbous-leafed Mushroom (Agaricus phalloides).
7. Thickfoot (Boletes pachypus).
8. Satanic Fungus (Boletus satanas).
9. Antler-Fungus (Calocera viscosa).
12. Witch-Fungus (Boletus luridus).

The chlorophyll-bearing Carpophytes comprise nearly 2,500 species, and are widely distributed in the salt and fresh waters of the globe. From these have sprung an enormous host of parasitic and saprophytic species, which are colorless, and constitute the great bulk of the fungi of the world, aggregating fully 100 times as many species as those from which they sprang.

In changing from the holophytic structure and habits of their ancestral types, these hysterophytes (fungi) have suffered much degeneration of the vegetative plant-body, while the reproductive apparatus has been relatively enlarged and multiplied. This is in accordance with the well-known law that since hysterophytes do not make carbohydrates they have little need of large vegetative bodies, and further, that since they are dependent upon particular hosts or organic matter for their food, they must provide more lavishly for propagation. Many of these fungi are little more than absorbing and reproducing organisms, the vegetative plant-body having almost entirely disappeared through disuse. These fungi are readily separable into two great classes, by characters derived from their reproductive apparatus. The first of these classes is known as the Sac Fungi, and the second as the Club Fungi.

Fig. 10

Fig. 11

Fig. 10.— *Empusa muscæ;* filaments from body of fly. Highly magnified.

Fig. 11.— A, several spore-sacs (*asci*) in different stages of development; B, a mature spore-sac. Highly magnified.

Sac Fungi (*Class Ascomyceteæ*).— The distinguishing mark of the plants of this class is that the spores which occur in their fruits develop in certain end cells and remain enclosed within the cell wall until matured. (Fig. 11.) These spore-containing cells have been aptly likened to sacs (Latin, *asci;* singular, *ascus*) and from this we derive the name of the class.

There are more species of sac fungi than of all other kinds. They range in size from very minute to many inches in extent. They include some of the most harmfully parasitic plants as well as many which live saprophytically upon refuse organic matter. Among the many families (more than 40) in this class, the following may be noticed:

Powdery Mildews (*Erysiphaceæ*) are to be regarded as primitive sac fungi, but little removed from their aquatic ancestors. The plant body consists of branching filaments which creep over the surfaces of their hosts, from which they obtain food by means of root-like absorbing organs, which penetrate the host cells. Certain branches form spores by the simple process of separating their terminal cells in succession and this is done so abundantly that the spores form powdery masses on the surface of the hosts. These spores float away on wind currents, and those that germinate on similar hosts give rise to new plants.

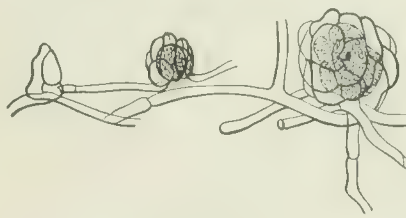


Fig. 12

Fig. 12.— Sexual organs of *Erysiphe* and formation of fruit. Highly magnified.

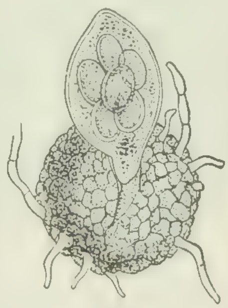


Fig. 13

Fig. 13.— Mature fruit of powdery mildew, with escaping spore-sac. Highly magnified.

The sexual organs (egg-cells and antherids) occur on the creeping filaments, and are short lateral branches, the former somewhat thicker than the slender antherids. (Fig. 12.) The two come in contact with one another, and the protoplasmic contents of the antherid pass into the egg-cell fertilizing it. As a result the egg-cell sends out one or more branches, the end cells of which develop into *asci,* while from below the egg-ceil there grows up a cellular, globular covering, constituting the outer wall of the fruit, and enclosing the *asci.* The spores in the *asci* when set free by the rupture of fruit and *ascus* walls, germinate and on similar hosts give rise to new plants. These fruits are usually blackish and may be seen by the naked eye as minute globular bodies on the mass of filaments. (Fig. 13.)

Truffles (*Tuberaceæ*) are evidently related to the powdery mildews, but their life history is not so well known. They are saprophytic, living on the decaying organic matter in the soil in forests. Little is known as to their early life, and the formation of their non-sexual spores, but these are thought to be somewhat like those of the powdery mildews. Their fruits are

formed under ground, and may be compared to a mass of compound fruits of the powdery mildews. The sexual organs, which probably precede the development of the fruits, have not yet been discovered. The fruits of the common truffles of Europe are from one to two inches in diameter, and warty and dark colored externally. (Fig. 14.) Internally they consist of a soft, whitish tissue, in which are numerous cavities, each containing several *asci.* Practically nothing is known as to their propagation. A few little known species occur in America, but in Europe they are common. See TRUFFLE.

Black Fungi (*Sphæriaceæ*) are typically parasites which grow in the tissues of higher plants, and whose small black fruits are formed on the surface of the host. Here again we are evidently dealing with plants related to the powdery mildews, but with an increased parasitism. They are known to form non-sexual spores much as in the powdery mildews. Their fruits also resemble the fruits of the powdery mildews, and probably result from a fertilization, but thus far the sexual organs have evaded discovery. (Fig. 15.)

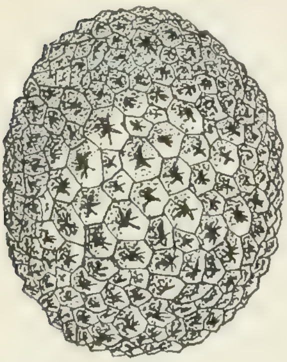


FIG. 14

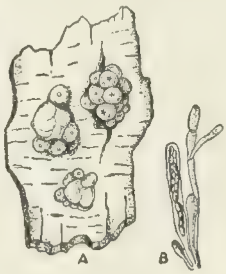


FIG. 15

FIG. 14.— Truffle; fruit, natural size.
FIG. 15.— *Nectria cinnabarina;* A, bark with enlarged fruits; B, spore-sacs. Highly magnified.

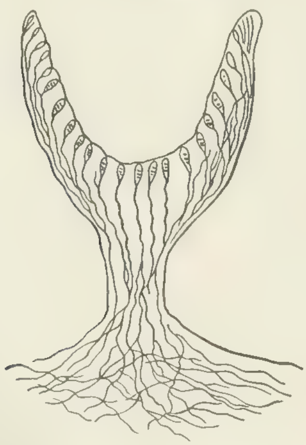


FIG. 16.— Diagrammatic vertical section of a cup fungus.

Cup Fungi (*Pezizaceæ*) are typically saprophytes (Figs. 16 and 17), growing in the tissues of decaying plants, as rotten logs, sticks, etc. In these fungi the plant is filamentous and grows through the decaying tissues as slender white, branching, threads. Non-sexual spores resembling those of the powdery mildews are known for some species. Sexual organs, consisting of a globular egg-cell, and a slender antherid, are found on

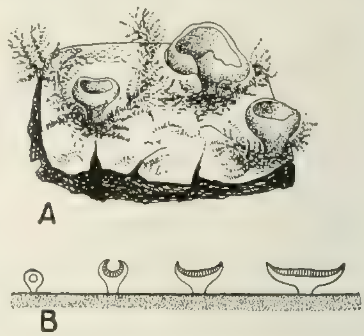


FIG. 17.— *Humaria rutilans;* A, three fruits, natural size; B, vertical sections of fruits of different ages.

the creeping filaments. (Fig. 19.) Fertilization takes place as in powdery mildews, with a similar result, the fruits, however, being at length cup-shaped instead of globular. In many species the fruits (Fig. 17) are globular when young, but as they mature they open out into cup-shaped structures (Fig. 17), in the concave surface of which are found many *asci.* (Fig. 18.) It will readily be seen that were these cup-fruits to remain closed, their structure would be closely similar to that of the fruits of the powdery mildews. However, the fruits of the cup fungi are often of considerable size, sometimes being as large as an inch or more in diameter.

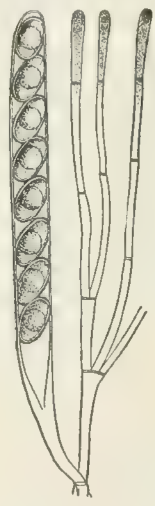


FIG. 18

FIG. 19

FIG. 18.— *Humaria rutilans;* spore-sac, and three paraphyses. Highly magnified.
FIG. 19.— Egg-cells and antherids of a cup fungus. Highly magnified.

Lichens (see article LICHENS) are now regarded as nearly related to the cup fungi and black fungi. (Fig. 20.) In all essentials they agree with those fungi, but they are usually treated separately on account of the peculiar parasitism and

EDIBLE FUNGI

1. Tasty Fungus (Lactarius deliciousus)
4. Early Toadstool (Helvella esculenta)
7. Stubble Fungus (Hydnum repandum)

2. Morchelle (Morchella esculenta)
5. Cantarelle (Cantharellus cibarius)
8. Butterfly Fungus (Boletus granulatus)
11. Parasol-Mushroom (Agaricus procerus)

3. Yellow Cockscomb (Clavaria flava)
6. Truffles (Tuber melanosporum)
9. Stone-Mushroom (Boletus edulis)
12. Champignon, or Cultivated Mushroom (Agaricus campestris)

symbiosis which they exhibit. There are several families of the lichen-forming fungi, aggregating between 2,500 and 3,000 species.

FIG. 20.— *Physcia stellaris*, a common lichen. Natural size.

Yeasts (*Saccharomycetaceæ*) are here briefly referred to in order to call attention to the excessive degradation which they have suffered. Although they consist of single cells, or short chains, they are now regarded as greatly reduced sac fungi. They grow in the watery solutions of sugars, starches, and other carbohydrates, and one result of their activity is the formation of alcohol, while at the same time carbon dioxide is set free. It is for the alcohol that yeasts are used in breweries and distilleries, and it is for the escaping carbon dioxide gas that they are used in the making of bread. See YEAST.

Rusts (*Uredinaceæ*) are minute plants, parasitic in the tissues of higher plants. (Fig 21.)

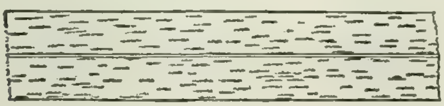


FIG. 21.— *Puccinia caricis*, a common rust on sedges.

They consist of branching filaments which grow through and live upon the host tissues. Certain branches cluster together and form rows of spores by terminal abstriction (*æcidiospores*) (Fig. 22 A) and later others form single terminal spores (*uredospores*) (Fig. 22 B), and still later other branches form one, two, or several thick walled spores in terminal *asci* (*teleutospores*). (Fig. 22 B.) These all begin within the host tissues, but they eventually break through the epidermis into the air. Lastly, when the teleutospores germinate each produces a short filament (promycelium) on which four minute spores (*sporidia*) develop. There are thus four kinds of spores in a typical rust plant, and these have been taken to characterize as many stages in the plant's life history, namely: 1. Cluster-cup stage (*æcidiospores*); 2. Red Rust (*uredospores*); 3. Black Rust (*teleutospores*); 4. Promycelium (*sporidia*). In most rusts these stages occur on the same host in the order given, but in some the first stage occurs on one host, and the remaining stages on another. The latter is the case with a rust of wheat, in which the cluster-cups occur on Barberry leaves, and the æcidiospores then germinate upon and infect the leaves of the wheat, on which the red rust, black rust and promycelium then follow in succession. No sexual organs have as yet been discovered, but analogy would suggest that they are to be looked for before the development of the teleutospores.

In this account the rusts are considered to be reduced sac fungi, of the cup fungus type, the degeneration being due to their excessive parasitism.

Smuts (*Ustilaginaceæ*) are still more parasitic than the rusts, and as a consequence have suffered still greater degeneration. (Fig. 23.) They grow wholly within their hosts, and do not even bring their spores to the surface. They consist of branching filaments which penetrate the tissues of their hosts, and at last form spores homologous with the teleutospores of the rusts. The latter in germinating produce sporidia. Comparing the rusts with the smuts we note that while there are four stages in the former, there are but two in the latter, the first and second having apparently disappeared.

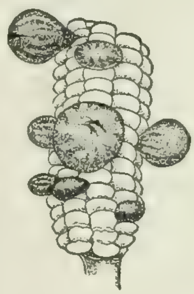


FIG. 23.— Portion of an ear of maize with eight of its kernels attacked by *Ustilago maydis*.

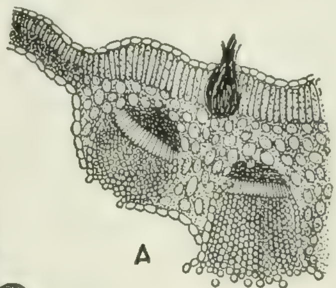


FIG. 22.— *Puccinia graminis*, a common rust of wheat. A, Cluster-cup stag on Barberry leaf; B, three uredospores and one teleutospore from a leaf of wheat. Magnified.

Imperfect Fungi.—At this point should be mentioned the so-called imperfect fungi, an immense aggregation of many thousand species (12,000 or more) of which we know but one stage (apparently the first) and so are unable to assign them to their proper place in the system. They are minute and mostly parasitic plants, occurring in the tissues of higher plants, and sending their spore-bearing branches out into the air. Some plants formerly placed here have been

found to be early stages of certain sac fungi (black fungi, or their relatives) and it is suspected that most, if not all, of them will eventually be so disposed. At present they are grouped under three general kinds, as follows:

Spot Fungi (*Sphæropsideæ*), which produce whitish or discolored spots, and later develop closed, spheroidal cases, containing free spores. *Septoria* and *Phyllosticta* are common genera.

Black-dot Fungi (*Melanconieæ*) are like the spot fungi, but there are no spore cases, the spores developing in masses beneath the epidermis which they eventually rupture. *Gloeosporium* is a common genus.

Moulds (*Hyphomyceteæ*) produce their spores on branches which grow out through the stomata of the host. Here we find the parasitic species of *Ramularia, Cercospora,* etc., and the mostly saprophytic species of *Monilia, Botrytis,* etc.

Club Fungi (*Class Basidiomyceteæ*).— The distinguishing mark of the club fungi (often spoken of as the higher fungi) is that the spores which develop in certain end cells in their fruits do not remain inside of these cells, but push out into the ends of terminal or lateral protuberances and so come to appear to be external. (Fig. 24.)

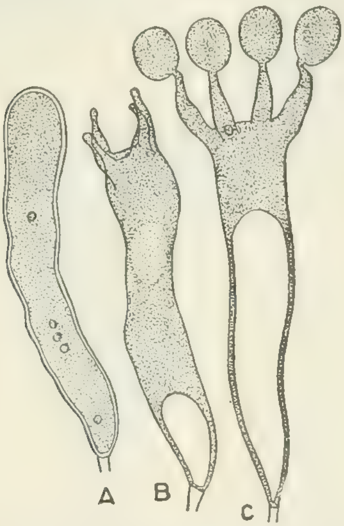


Fig. 24.— Spore-clubs in different stages of development: A, when very young; B, with the spore-branches beginning to form at the summit; C, showing the spore-branches with nearly mature spores at their ends. All highly magnified.

These club-shaped, spore-bearing cells are technically known as *basidia* (singular, *basidium*), whence the scientific name of the class. The spore-clubs (*basidia*) of this class are regarded in this discussion as the homologues of the spore-sacs (*asci*) of the preceding class.

Between 10,000 and 12,000 species of fungi of this class are known. Many attain to considerable dimensions, especially their fruits. They are typically saprophytic, but it is now known that many of them are more or less parasitic, also, when the opportunity offers.

About 10 families are commonly recognized, four of which, only, will be noticed here.

Puff-balls (*Lycoperdaceæ*) are saprophytes whose branching filaments penetrate decaying wood or earth rich in organic matter, and finally produce globular fruits which rise above the surface. (Fig. 25.) These fruits are filled with tortuous canals whose walls are studded with spore-clubs (basidia) on which the spores are produced. At maturity the interior tissues of the fruits deliquesce, setting free the spores, which escape into the air a little later as a dusty cloud, by the rupture of the fruit-wall. From these spores new plants are produced, but we do not know the whole life history of these common fungi. Although the sexual organs should precede the formation of the fruits, they have not yet been observed

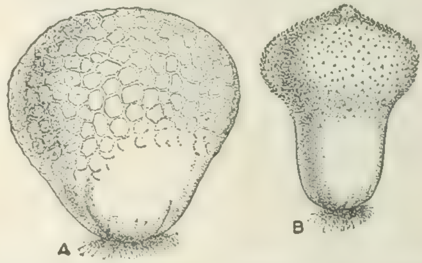


Fig. 25.— Two species of puff-balls; A, *Lycoperdon cœlatum;* B, *Lycoperdon gemmatum.*

Stink-horns (*Phallaceæ*) are closely related to the puff-balls, which they closely resemble in all stages excepting the last. Here the spore-bearing portion of the globular fruit is confined to a vertical, circular layer of tissue about midway between the centre and the circumference. At maturity the spore-bearing tissues deliquesce and at the same time the tissues below rapidly elongate, bursting the fruit-wall and carrying up the spores into the air. (Fig. 26.) These fruits

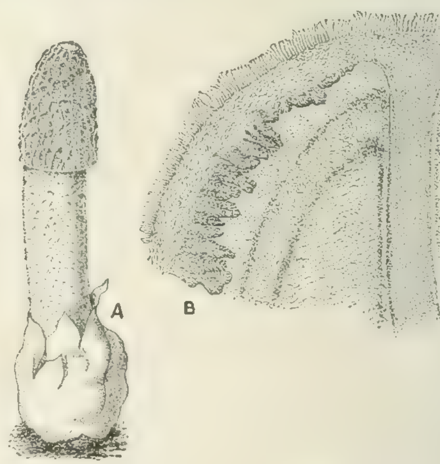


Fig. 26.— A, a stink-horn (*Ithyphallus impudicus*) after the rupture of the volva; B, highly magnified section of the spore-bearing layer.

have very bad odors, which attract insects, and it is thought that these help to distribute the spores. Stink-horns are from an inch or two to six or more inches in height, and grow commonly in lawns and pastures, where their presence is indicated by their intolerable odor.

Toadstools (*Agaricaceæ*) are fungi of the puff-ball kind, consisting of white, branching filaments which creep through the nutrient sub-

FUNGI.—MUSHROOMS AND THEIR AFFINITIES.

Fig. 1 Vertical Section through Fungus. 2 Under surface of Pileus or Cap. 3 Reproductive Organs. 4 Amadou or German Tinder. 5 Edible Cantharellus. 6 Common Mushroom. 7 Smaller Fasciculate Agaric. 8 Sweet-smelling Hydnum. 9 Imperial Mushroom. 10 Goat's beard or Yellow Flavaria. 11 Fly-blown Mushroom. 12 Socket Peziza. 13 Bell-shaped Bird's-nest. 14 Dry-rot Fungus. 15 Umbellate Polyporus. 16 Hypoxylon polymorphum. 17 Longitudinal Section of do. 18 Truffle. 19 Delicious Agaric. 20 Edible Boletus. 21 Edible Helvella. 22 Round-headed Morel. 23 Latticed Stinkhorn. 24 Warty Puff-ball. 25, 26 Hysterium of the Ash. 27–28 Brown Pulvinate Sphæria.

stance or the host tissues. Most species are saprophytes, but some are parasites. When the fruits are young they resemble those of puffballs, but as they grow older a circular layer of spore-bearing tissue develops, and this, by the rapid growth of lower lying tissues, is carried up on a stalk, very much as is done in the stink-horns. (Fig. 27.) Here, however, the stalk is

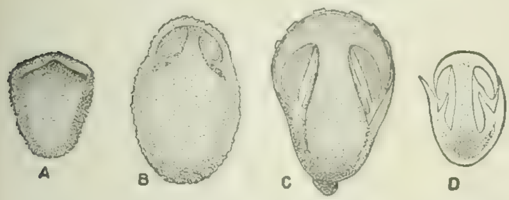


FIG. 27.— Development of a toadstool (*Amanita muscaria*) shown in vertical section. A, very young stage; B and C, later stages; D, after the bursting of the volva.

formed earlier, and the spores are usually developed after the rupture of the fruit-wall.

A typical toadstool fruit has the following structure: There is first at the bottom the cup-shaped remnant of the original fruit-wall (technically, the *volva*); from this rises the cylindrical stem (*stipe*), terminating in an expanded cap (*pileus*). The stem and cap together resemble on expanded umbrella, or a one-legged stool (Fig. 28), from which latter fact the common name "toadstool" was doubtless suggested. The lower surface of the cap is folded into many vertical radiating plates, called gills (*lamellæ*), and these are studded with the spore-clubs, bearing the spores. This gill portion corresponds to the circular spore-bearing layer of the stink-horns, and the gills themselves are to be regarded as devices for increasing the number of spores, by an enlargement of the surface studded with spore-clubs.

FIG. 28.— Two fruits of *Armillaria mellea* attached to the filamentous plant; several young fruits at the left. Considerably reduced.

While in typical toadstools the cap is rounded and centrally attached to the stem, in some species its growth is not uniform, and the stalk is excentric, or even lateral. Lastly, let it be remembered that the toadstool which we see is not the plant itself (that is below the surface) but it is the fruit of the plant which develops in order that it may produce spores.

Pore Fungi (*Polyporaceæ*) are so named because the spore-bearing structure on the under side of the cap of the fruit consists of a mass of small vertical pores, instead of plates, and by this character they may be readily recognized. In typical pore fungi the general structure and development are similar to those of the toadstools, the change from gills to pores being the only important difference. Here, however, many of the species instead of growing into regular umbrella-shaped fruits, have the stalk more or less laterally placed. In others, again, the lateral stalk is very short, and from this the step is a very short one to its complete suppression, when the cap is sessile marginally, as in the bracket fungi, which are so common on decaying logs and other forms of timber.

Some pore fungi are fleshy, but for the most part they are hard and tough, often resisting

FIG. 29.— *Agaricus campestris*, the cultivated mushroom, showing several stages of development.

decay for many years. Some of the species are perennial, adding successive layers of pore tissue to their fruits for some years.

ECONOMIC RELATIONS OF FUNGI.

The economic relations of the fungi are of great importance. Some are edible, and furnish wholesome food to man and other animals, some are used in the arts, some yield medicines, some are the cause of disease in man and other animals, and some again attack and destroy other plants, including many of the cultivated plants of our farms and gardens.

Edible Fungi.—Here perhaps we should include those bacteria which have to do with the flavor of butter and cheese, and those moulds whose presence in cheese adds to its edibility. Of far greater importance, however, are those species which are eaten for the nutriment which they contain. Truffles are collected in Europe, and sold in the markets. Dogs and pigs are trained to search for them, the attendant bagging the truffle when found by the keen scent of the animal. The Morels are sac fungi related closely to the cup fungi; each Morel (fruit) is a hollow-stalked body two to five inches high, with a crinkled and pitted conical cap in whose surface are imbedded the spore-sacs. They grow in fields and thickets, and when fresh are wholesome. Morels are often called mushrooms, although this name should be restricted to the next group.

Mushrooms (Fig. 29) are of the toadstool kind, and popularly any species which is edible is called a mushroom, while those which are poisonous are called toadstools. Many species

are collected from the forests and fields by experts who have learned to distinguish them from the poisonous ones, but by far the most commonly used species is the common mushroom (*Agaricus campestris*) which is cultivated by gardeners for this purpose. See MUSHROOMS.

Medicinal Fungi. — The most important species is the Ergot (*Claviceps purpurea*), one of the sac fungi, which is parasitic in the heads of rye.

Pathogenic Fungi (on Animals).—Many bacteria are the direct cause of diseases of animals, including man. See BACTERIA.

Some of the water moulds cause a serious disease of fishes, especially of young fishes in "hatcheries." Occasionally an epidemic, known as the "Salmon Disease," has been known to occur in the streams of Great Britain. Investigation has shown it to be due to a certain species of water mould.

The insect fungi (*Entomophthoraceæ*) annually destroy immense numbers of flies, locusts, caterpillar larvæ, etc. The common house fly is attacked by *Empusa muscæ* in summer and autumn. Every infected insect fastens itself by means of its tongue to some object, and soon perishes miserably, its body walls being pierced by innumerable spore-bearing branches. In the autumn myriads of locusts ("grasshoppers") are destroyed by *Empusa grylli.* When attacked by the fungus the locust climbs a grass or weed stem around which it finally clasps its legs and dies firmly attached. Many other insects, including mosquitoes, are destroyed by these beneficial fungi. Thus far all attempts to artificially apply these fungi in combating insects have been unsuccessful.

Pathogenic Fungi (on Plants). See DISEASES OF PLANTS.

CHARLES E. BESSEY,
University of Nebraska.

Fungicides, fŭn'jĭ-sīd, any agent used to prevent the growth of fungi or their spores. The most important uses of fungicides are in agriculture and horticulture for controlling the fungi that attack crops. These may be divided into two general classes: (1) Fungi which burrow among the tissues of the host plants and expose little more than their fruiting organs to the air. (2) Fungi which expose almost all of their vegetative parts to the air, only the holdfast, absorbing organs (*haustoria*) entering the tissues of the host. From the nature of their growth it is easily seen that members of the second group may be attacked at any time, but that since the vegetative parts of members of the first group are protected by the tissues of the host they cannot be reached effectively by any fungicide without injuring the host. Controlling agencies in such cases must therefore be preventive.

For the control of the exposed fungi the chief agent is sulphur in out-door practice, applied as a powder, which is dusted upon the foliage, preferably with a powder gun. In the greenhouse it is more frequently evaporated, by strewing powdered sulphur upon the heating pipes or upon burlap suspended in warm parts of the greenhouse. This is a slow way, and is mainly preventive. When a considerable quantity must be evaporated in a short time the sulphur is gently heated over an oil stove. It is imperative that the sulphur be kept from igniting, because the fumes are destructive to host as well as fungus. For cleansing a greenhouse of objectionable fungi when the plants are out, the sulphur may be burned and all reachable parts sprayed liberally with Bordeaux mixture.

Various compounds of copper are used as preventives of the attacks of internal feeding fungi and as remedies for the exposed. Chief of these salts is copper sulphate, which may be applied in a pure solution only to dormant wood, walls, etc. It is used at the rate of one pound to the gallon, and will, at this strength, destroy lichens and algæ as well as fungi. For use upon foliage and other actively growing parts it must be mixed with some substance which will counteract its causticity. Lime is most frequently used, and the compound is called Bordeaux mixture from the French city where its usefulness was accidentally discovered about 1882. It is made as follows: A known number of pounds of copper sulphate are dissolved in an equal number of gallons of water, contained in a wooden tank or barrel, the salt being suspended at the surface of the water to ensure quick solution. In another receptacle a known number of pounds of lime, as free from magnesium as possible, are slaked with a little water, and when slaking is complete, enough more water is added to make the proportion one pound of lime to a gallon of water. When needed for use six gallons of the copper sulphate solution and four or five of the lime solution are separately diluted with enough water to make a combined total of 50 gallons. The two diluted solutions are then thoroughly mixed, and afterward tested with ferrocyanide of potash to make sure that there is no uncombined copper sulphate. A brownish discoloration indicates that more lime must be added to neutralize the free copper salt. The mixture is then ready for general use, but for peaches, plums, cherries, and some other plants, another 25 gallons of water must be added because of the susceptibility of the foliage to injury. The stock solution of copper may be kept for weeks, but the lime solution should stand for only a few days and the completed mixture for only a few hours, because the particles tend to flocculate and settle, a process which impairs the usefulness of the mixture.

Copper sulphate is often used as *eau celeste,* a solution of one pound of the salt to two gallons of water plus three half-pints of standard ammonia, and then diluted with water to make 25 gallons. Since the strength of the ammonia varies, this solution often burns the foliage, there being insufficient ammonia to neutralize the free copper sulphate. This fungicide and ammoniacal solution of copper carbonate are used when a non-staining solution is needed, as in spraying ornamental plants and fruit which is nearing maturity. The latter solution is made by dissolving one ounce of copper carbonate in one pint of ammonia and mixing with 10 gallons of water.

The seeds of various cereals are often dipped in hot water formalin solution and copper sulphate solution to destroy fungous spores, and hot water is also used to some extent for destroying exposed fungi, spores, etc.

All solutions must be applied as a mist-like spray, to ensure which a nozzle with a small aperture is essential. The first application to fruit trees should be before the buds begin to

swell. This may be a stronger solution than those used after growth starts. The second should be given when the buds begin to swell, the third when the blossoms have fallen. No spray should be given during the blossoming period.

Consult: Lodeman, 'The Spraying of Plants' (1890); Prillieu, 'Maladie des plantes agricoles' (1895); Massee, 'Text-book of Plant Diseases' (New York 1899); various bulletins of the United States Department of Agriculture and of many of the State Agricultural Experiment Stations.

Fungus, fŭn'gŭs. See FUNGI.

Fungus-eaters. The fungi enter largely into the food of the lower animals, and somewhat into the fare of the higher forms. The moulds, slimes, and various aquatic forms are devoured by echinoderms and mollusks, both bivalves and univalves, who take in the minute floating forms, or their spores, or eat the fixed growths from stones and other resting places, and by vegetable-eating fishes and crustacea. Pond-snails will keep the glass sides of an aquarium clean of vegetable growths, a large part of which is fungoid. Worms, slugs, and insects in great variety feed upon the vast array of fungi not aquatic. Beetles are especially fond of the larger forms — the toadstools and tree-borne polypores. A large Javan beetle, known from its shape as the "fiddle-beetle" (*Mormolyce phylloides*), spends its life within and about certain fungi growing on tree-trunks. A whole family of small flies (*Mycetophilidæ*) breed in fungi, including the cultivated mushroom, beds of which are often largely damaged by the work of their maggots bred there; hence the group is termed "fungus-gnats." In the United States the woodland toadstools are eagerly fed upon when ripe in August and September, not only by great numbers of insects, slugs and snails, but by salamanders, tortoises (especially), and by all sorts of squirrels; but they seem to be rarely if ever eaten by birds. For the edibility of fungi by man, see MUSHROOM.

Fungus-gnat. See FUNGUS-EATERS; GNATS.

Funk, fŭnk, **Isaac Kauffman,** American publisher: b. Clifton, Ohio, 10 Sept. 1839. He was graduated at Wittenberg College, Ohio, and after several pastorates, the last of which was in Brooklyn, N. Y., began a publishing business in 1872; founded and published the 'Metropolitan Pulpit' (now the 'Homiletic Review') in 1876, and the 'Literary Digest' in 1890. He has published also the 'Standard Dictionary' of which he was editor-in-chief (1890–4). He is an earnest Prohibitionist, and in 1884 founded the 'Voice,' a prohibition journal, and has been the Prohibition candidate for mayor of New York. In 1901 he began the publication of the important 'Jewish Encyclopedia.'

Funnel-marks, painted designs on the funnels of ocean steamships to designate the ownership of the vessel. American line steamships are thus designated by a black funnel, white band, with black top; Anchor line, black funnel; Cunard line, red funnel, with black rings and black top; French line, red funnel with black top; White Star line, cream funnel with black top; Wilson line, red with black top; North German Lloyd line, cream funnel; Red Star, black funnel, white band, black top; Netherlands line, black, with white band and green borders; Hamburg-American line, buff for express steamers, black for regular steamers; Scandinavian-American line, yellow, with white band and blue star, and black top; Bristol line, black, white band in centre, blue star in centre of white band.

Funston, Frederick, American military officer: b. New Carlisle, Ohio, 9 Nov. 1865. He was educated at the State University, Kansas, and was a commissioner of the Department of Agriculture to explore Alaska 1893–4. He served in the insurgent army in Cuba in 1896–7, and, receiving in 1898 a commission as colonel of the Twentieth Kansas Volunteers, went to the Philippines, where he became brigadier-general of volunteers the next year. In March 1901, he commanded an expedition which succeeded in capturing the Filipino leader, Aguinaldo, and was appointed brigadier-general in the United States army in the same month.

Fur-bearing Animals. In the broader sense any animal which yields a pelt used in the preparation of marketable furs. In a narrower, more zoological sense, the term is restricted to that family of carnivora, the *Mustelidæ*, which contains the weasels, martens, sables, badgers, skunks, wolverines, otters, and sea-otters. The family is not a large one, but is of great economic importance, and many of its genera and species are of very wide distribution, mostly in northern regions. Two groups, the Arctic sea-otter and the skunks, are exclusively American. All are small animals; fierce, and voracious, living in burrows, or holes in trees or rocks, and active in winter. They belong in the arctoid division of carnivores, are most nearly related on the one hand to the bears and on the other to the dogs. For further particulars see FUR-TRADE; and the names of prominent species, as: BADGER; FERRET; MARTEN; OTTER; POLECAT; SABLE; SEA-OTTER; SKUNK; WEASEL; WOLVERINE; etc. Consult: Elliott Coues, 'North American Mustelidæ' (Washington 1877).

Fur Seal, the fur-bear or northern fur-seal (*Otaria*, or *Callorhinus, ursina*), whose pelts form the seal-skins of commerce. (See FUR TRADE.) There is also a southern fur-seal (*O. nigrescens*), dwelling along the southern coast of South America. See SEAL.

Fur Trade, The. The history of the fur trade is so closely interwoven with the early history of America that it is extremely difficult to narrate one without reference to the other. Among all the industries that helped to make this country one of the great commercial nations of the world there was none that exerted such an important influence upon the early prosperity of the colonies as that which was represented by those who took the pelts of animals and prepared them for manufacture into various articles for the use of mankind. It was the rich peltries of North America that were the magnet that attracted the hardy French and British adventurers to the shores of the new world, and it was their brawn that blazed the trail through the wilderness that the more timid agriculturalist might have the courage to follow in their footsteps. In the early days of this country's history it was the hunter and the trapper who explored the unknown regions. To obtain the furs that represented one of the great sources of wealth in the new country they journeyed into the most distant and inaccessible

parts of the land, and that they might have havens of safety in which to store their pelts, and, incidentally, rest secure from the attack of savage foe, they established the small settlements, so many of which have since grown into prosperous communities. It was the fur trader, therefore, who was the real pioneer in North America. Always in advance of civilization, his labors in leading the way for the settlement of the country provided a means of advancement that would have been much delayed if it had not been for these preparatory efforts. The Canadian provinces, for example, owed practically all their primary prosperity to their fur trade. In those days there were no mines to stimulate the immigration into that country, and the French pioneers who first made it their home soon discovered that there could be no more profitable source of income than that which was afforded by the possibility of trading in furs, for in Canada, as throughout the English colonies further south, the native Indians were so ignorant of the value of the pelts which they gathered that they were willing to dispose of them upon terms that permitted an enormous profit to the successful trader in such articles.

During the early days in the history of the fur industry in North America there was practically no limit to the percentage of profit that could be made in buying furs. To become a successful trader in pelts the one thing that was necessary was to import a large quantity of cheap and practically worthless trinkets from Europe. For these the Indians would exchange the most valuable peltries without hesitation. In fact, the conditions under which the fur trade with the natives was conducted soon became such a serious scandal that reformatory measures were absolutely necessary, the better class of traders becoming unwilling to sanction the unmitigated dishonesty and unbridled licentiousness of the class of men who were known as *coureurs des bois*, or rangers of the woods. It was to suppress this class that the licensing system was introduced, and, although this too soon became subject to abuse, for a time at least it tended to free the traffic from its most scandalous conditions.

It was during these early days that the feuds between the British merchants of New York and the Canadian traders became a serious factor in the industry. There can be little doubt that the former set out deliberately to encroach upon the business of the fur interests of Canada, and the trouble regarding the infringement of territorial rights had become a most serious situation when the Hudson's Bay Company was formed, in 1670. This company, which was chartered by Charles II., had the exclusive privilege of planting trading stations on the shores of Hudson Bay, and all its tributaries, and when, about a century later, France lost possession of her Canadian colonies, the Britons assumed almost exclusive control over the great fur trade of America. Prior to the beginning of the 19th century this trade was chiefly monopolized by the powerful trading companies.

First in the field, of course, was the Dutch East India Company, with its prosperous trading-posts at New Amsterdam (now New York), Beaverwyck (now Albany), as well as at several points on the Delaware and on the Maine coast. Next came the extensive Hudson Bay Company, which practically monopolized the trade in furs for 200 years, or until the Northwestern Company entered the field and established a somewhat successful rivalry, although its efforts were confined almost entirely to the Pacific coast.

It was in 1808 that John Jacob Astor formed the American Fur Company, establishing a line of trading-posts that extended across the continent, with a depot for furs at the mouth of the Columbia river, from which point he intended to ship direct to China and India. The name of the concern was afterwards changed to the Pacific Fur Company, and Mr. Astor saw his enterprise on the high road to success, when, in 1813, he was treacherously sold out to the Northwest Company by his resident partner, the latter claiming that, as the United States was then at war with Great Britain, the British soldiers would have taken the establishment by force if he had not made other disposition of it. After this incident, Mr. Astor confined his operations to the district east of the Rocky Mountains, where he, with his partner and successor, Ramsay Crooks, transacted a profitable business in furs for many years. The Russian-American Fur Company, which had its main trading post at Sitka, Alaska, with many subordinate posts on the Yukon, carried on an immense traffic in such lines until 1867, when all its rights and properties were transferred to the United States with the purchase of Alaska.

It was somewhat prior to 1809 that John Jacob Astor conceived his great project to make the American fur trade independent of the Hudson's Bay Company. As his scheme was partly based upon the fact that such an enterprise would have a strong tendency to spread the civilization of the East into the far western country, he asked the aid of Congress in carrying it into execution. Briefly described, Mr. Astor's idea was to establish a connected chain of trading posts from the Great Lakes to the Pacific Ocean, with a central depot for packing and shipment at the mouth of the Columbia river; to acquire one of the Sandwich Islands as a provision station, and to establish a line of vessels to sail from the west coast of North America to the most important ports in India and China. Washington Irving, in his "Astoria," presents a graphic description of this gigantic enterprise which met with such a strange disaster when Astoria, the town founded at the mouth of the Columbia river in 1811, was so unnecessarily abandoned during the War of 1812. The balance of Mr. Astor's career, however, was quite as remarkable. Year after year his fur business was extended until its operations surpassed those of any house that had hitherto been established. In addition to its immense American business a gigantic export trade was carried on with many countries, and, when the founder of the company died, he left a fortune that was estimated at $20,000,000. William Backhouse Astor, his son, was interested with him in the fur trade, and when, in 1827, the house of John Jacob Astor & Son was merged in the American Fur Company, he became its president.

The first great establishment founded in St. Louis — one of the principal depots of the fur trade from the middle of the 18th century until 1859 — was that of Laclede, Maxon & Com-

pany, in 1763. In the early days of this house the brothers Auguste and Pierre Chouteau were connected with it, and the establishment, which was extremely successful, employed a large number of trappers and voyageurs. In 1808, the Chouteau brothers and a number of their associates in the older firm, withdrew to form the Missouri Fur Company. This prospered until about 1813, when, because of the war with Great Britain, it was dissolved. During the next few years several of its members transacted business independently, but, in 1827, the Rocky Mountain Fur Company of St. Louis was formed to send trappers to the Pacific coast. At this time the perils of the work were so great that fully 40 out of every 100 persons employed in it perished, and yet the life of adventures offered so many fascinations that there was no lack of hardy men eager to take the places of the slain. After several years of varying success the company was dissolved. In 1834, however, Pierre Chouteau, Jr., who had been educated in the fur trade by his father, organized the house of Pierre Chouteau, Jr. & Company, a firm name which was practically a household word among hunters and trappers from the Mississippi and the Lakes to the Pacific during the next 25 years. In 1859, the business was sold to Martin Bates and Francis Bates of St. Louis and New York.

The year 1859 saw the American fur trade more widely diffused than ever before. The passage of the industry into the hands of individuals had commenced to be apparent as early as 1821, and while, by the middle of the century the aggregate amount collected each year was much greater than it had been 40 years previously, the opportunities for making great fortunes in the trade had gone. A writer in 'Silliman's Journal' (1834) gives an interesting description of the situation of the fur trade at that time. He says:

«The Northwest Company did not long enjoy the sway they had acquired over the trading regions of the Columbia. A competition, ruinous in its expenses, which had long existed between them and the Hudson's Bay Company ended in their downfall and the ruin of most of the partners. The relict of the company became merged in the rival association, and the whole business was conducted under the name of the Hudson's Bay Company. This coalition took place in 1821. Almost all the American furs which do not belong to the Hudson's Bay Company find their way to New York and are either distributed thence for home consumption or sent to foreign markets. The Hudson's Bay Company ship their furs from their factories of York Fort and from Moose River, on Hudson Bay; their collection from Grand River, etc., they ship from Canada; and the collection from Canada goes to London. None of their furs come to the United States, except through the Indian market. The export trade of furs from the United States is chiefly to London. A quantity of beaver, otter, etc., is brought annually from Santa Fe. Dressed furs for edgings, linings, caps, muffs, etc., such as squirrel, genet, fitchskins, and blue rabbit, are received from the north of Europe; also cony and hare's fur; but the largest importations are from London, where is concentrated nearly the whole of the North American fur trade.»

It was as early as 1834 that those who were interested in this industry began to fear that the American fur trade had commenced to decline and, even at that time, it was quite freely predicted that its downfall would be rapid. By this period there were practically no new lands to be explored. The hunters and trappers in the employ of the great fur trading companies had gone everywhere and had slaughtered so indiscriminately that it seemed almost impossible that the fur-bearing animals should not be exterminated. While in some few cases this prediction has been proved to be only too true in a majority of instances the fear has been shown to be without foundation, for many of the fur-bearing animals, especially the small mammals, actually increased in number. They seemed to thrive better in the neighborhood of small settlements, where they were able to feed upon the farmers' crops. Some of the larger species, like the bear or the beaver, were much reduced in number, although even they did not meet so sad a fate as that of the buffalo, which has now been reduced to a few herds which are being cared for in southern Canada and in the Yellowstone Park. Up to 1875 these animals existed in countless herds on the western plains, where they were of incalculable value, to the Indian as well as to the white man, not only on account of the fact that their skins represented one of the most important commodities in the fur trade, but for the reason that they supplied both the white adventurer and the Red-skin native with food and clothing. Soon after 1870, however, the popular demand for this fur became so great that it is estimated that not less than 4,500,000 of these animals were recklessly killed, merely for the sake of their hides, between the years 1871 and 1874, and it is this ruthless extinction of the buffalo that is responsible for the conditions which now compel the United States Government to supply the Indians with regular meat rations. Of the millions of buffaloes that roamed the plain before the fur companies commenced their campaign of slaughter only a few hundred still remain, and they are so safely guarded that it is hoped that the species may be preserved from absolute extinction.

The table on following page presents a list of the principal fur animals of America, with such descriptive facts concerning them as can be tabulated, and the uses to which their skins are applied.

Among all these fur-bearing creatures the seal is of paramount interest to the trade owing partly to the great demand for such skins and partly to the efforts that are being made to prevent this valuable mammal from following the buffalo into comparative oblivion. There are many varieties of seals, but the four which are most extensively used by the trade are the Alaskan, Victoria or Northwest coast, Copper Island, and Lobos Island. Of these the most extensive fishery is the Alaskan. It was a material element in determining the value of the Alaskan province when it was purchased from Russia at a heavy cost by the United States, and it was one of the principal inducements upon which the purchase was made. That those who engineered the purchase of this territory were not mistaken in their valuation of the seal fisheries has been shown by the fact

PRINCIPAL AMERICAN FUR ANIMALS.

Common name	Scientific name	Habitat	Color	Uses
Beaver	Castor fibre	N. America, N. Europe, Asia	Chestnut brown	Muffs, trimmings, robes.
Silver fox	Canis vulpes	Northern latitudes	Silver gray	Muffs, trimmings, boas, robes.
Cross fox	Canis vulpes	Northern latitudes	Silver gray	Muffs, trimmings, boas, robes.
Red fox	Canis vulpes	Northern latitudes	Red	Muffs, trimmings, boas, robes.
Arctic fox	Canis vulpes	Northern latitudes	White	Muffs, trimmings, boas, robes.
Blue fox	Canis vulpes	Alaska, Greenland	Slate or purple	Muffs, trimmings, boas, robes.
Gray fox	Canis vulpes	Virgina	Gray	Muffs, trimmings, boas, robes.
Raccoon	Procyon lotor	N. America	Grayish yellow	Robes, rugs, gloves.
Wolverine	Gulo luscus	N. America, Europe, Asia	Dark brown	Robes, muffs, trimmings.
Fisher	Mustela pennanti	N. America	Dark brown	Muffs, boas.
Mink	Mustela vison	High latitudes	Dark brown	Muffs, boas, capes.
Lynx	Felis Canadensis	N. America, Europe	Silver gray	Robes, muffs, boas, collars.
Wildcat	Felis rufa	N. America	Yellowish brown	Robes.
Skunk	Mephitis mephitica	N. America	White and black	Muffs, collars
Black bear	Ursus Americanus	Northern latitudes	Black	Rugs, robes.
Cin'am'n bear	Ursus cinnamonum	Northern latitudes	Dark brown	Rugs, robes.
Grizzly bear	Ursus ferox	Northern latitudes	Brown	Rugs, robes.
Polar bear	Ursus maritimus	High latitudes	White	Rugs, robes.
Isabella bear		Northern latitudes		Ladies' goods.
Badger	Taxidea Americana	N. W. America	Sandy gray	Painters' brushes, muffs, boas.
Sea-otter	Enhydris lutris	N. Pacific	Dark brown	Coats, muffs, collars, caps.
Otter	Lutra Canadensis	N. America, Europe	Chestnut	Muffs, collars.
Fur-seal	Callorhinus ursinus	Alaska, Shetland	Yellowish gray	Mantles, cloaks.
American wolf	Lupus Occidentalis	N. America	Black, gray, white	Robes, rugs.
Prairie-wolf	Lupus latrans	N. America	Dark gray	Robes, rugs.
Panther	Felis concolor	All America	Light dun	Robes, rugs.
Musk-ox	Ovibos moschatus	Upper Canada	Dark brown	Sleigh-robes.
Buffalo	Bison Americanus	N. W. America	Drab brown	Robes, coats.
Marten	Mustela Canadensis	N. America	Light brown	Coat lining, capes.

that since Alaska became the property of the United States this industry has afforded a very considerable source of revenue to the Government through the lease of the seal fishing privileges, while the furtherance of this industry has not only engaged a large amount of American capital but has provided employment for a large number of American people.

From the early part of the 19th century until 1862 the seal fisheries were leased by the Russian Government to the Russian-American Company, a corporation composed of several wealthy Siberian merchants, but when the United States assumed control of the Alaskan territory these rights reverted to this Government. Even at this early date the question of the possible extinction of the seal had been seriously agitated, and it was not long after American acquisition of the territory that Congress passed a law forbidding the killing of seal upon the islands of St. Paul and St. George except during the months of June, July, September, and October. The laws further prohibited the killing of females, or males under one year of age, and it forbade the use of firearms; the taking of seal in adjacent waters, or on places where they were accustomed to haul up to remain, and limited for a term of twenty years the number to be killed on these islands to 100,000 annually, reserving the right to further restrict the number if at any time it appeared necessary or advisable to do so in order to prevent the serious reduction of the species.

The Alaskan Commercial Company obtained its lease of the seal fisheries in 1870. It continued for a term of 20 years, and gave the corporation the right to take seal, under the regular Government restrictions, in return for a rental of $50,000 per annum, and a further tax of $2 for each seal thus taken. The headquarters of this corporation were in San Francisco, John F. Miller, afterwards senator from California, being its first president. He was soon succeeded by Lewis Gerstle, one of the original stockholders, and the affairs of the company were principally directed by Messrs. Gerstle, Sloss, Niebaum, and Neumann on the Pacific coast, by Mr. Hutchinson at Washington, and by Sir Curtis Lampson (since deceased) at London. As the Government became pretty well persuaded that the amount of revenue received from the fur-seal fisheries had not corresponded with the number of seals taken, the lease was not renewed, but instead, when it expired, 1 May 1890, a lease was granted to the North American Commercial Company for the ensuing twenty years. This lease, which expires 1 May 1910, gave them the exclusive right to take seals in Alaskan territory for an annual rental of $60,000 and a tax of $2 per head upon all seals taken, and an additional bonus of $7.62½ on each skin. Even under such new conditions matters did not turn out satisfactorily, however, and the United States Government finally brought suit against the North American Commercial Company to recover $214,293.37, a sum alleged to be due on the company's contract since April, 1895. The case was fought through the lower courts and was finally settled in the Supreme Court of the United States. This suit has been regarded as one of the utmost importance and is reported in full in the 171 U. S. p. 137. The action, as brought by the Government, was to recover the annual rental of $60,000, as well as the tax and the bonus on each skin. The court found that there was no abatement on account of the tax or bonus, but held that the rental should be reduced in proportion as the whole number of skins allowed to be taken in any one year bore to the maximum allowed by law. As the result, instead of paying a stipulated rental of $60,000 per year, the North American Commercial Company now pays a fixed rental of 60 cents for each skin taken, which, with the tax and bonus, makes a total payment to the Government of $10.22½ per skin taken and shipped.

During the past few years the Government has restricted the lessees of the seal fisheries to a limited catch per year. The following table shows the maximum limit of seals allowed to be killed and the total number taken and shipped from 1859 to 1905 inclusive:

RESTRICTION AND SHIPMENT OF FUR SEALS.

Year	Allowed to be killed	Shipped
1895	15,000	15,000
1896	30,000	19,200
1897	20,000	16,818
1898	30,000	18,032
1899	30,000	16,812
1900	30,000	22,470
1901	30,000	22,672
1902	30,000	22,368
1903	30,000	19,292
1904	15,000	13,128
1905	15,000	14,368

In fact, as the matter now stands, the Government annually fixes a maximum and minimum number of seals that may be killed, and before the opening of the season the approximate number to be taken is fixed upon by the agent stationed at the Alaska fisheries.

The first seals to arrive at the Pribylov Islands each season are the bulls, each one of which immediately proceeds to locate the "homestead" that he and his future harem are to occupy. This "homestead" is about 10 feet square, and, as there is considerable space to be filled, the competition in the beginning — from the 1st to the 5th of May — is not very great. A few days later, however, the breeding grounds become so crowded that late comers find no place to locate their "homestead," with the result that the most terrific combats ensue, some of which are attended with mutilation if not, as is quite frequently the case, by death. The bulls who do not succeed in obtaining a place, or who are unable to oust others from their stronghold, are compelled to live apart from their companions. They are mainly old bulls who have been weakened by age, or young bulls, less than five years of age. The "whites" call them "bachelor seals," while the Aleuts know them as "holluschickie," and they usually number from one-third to one-half of the entire herd.

It is from these bachelor seals that the lessees of the islands are permitted to take the skins that are shipped in batches of 200 to 300 casks to London that they may be sold at auction, the great fur sales being held in that city. Each cask contains from 40 to 45 skins, which are rolled up separately, tied with cord, and packed in salt.

Nearly all the vessels that are employed in the seal fishery are the property of Canadians, but are manned by Indians, the latter making the most successful hunters, and their operations are conducted as follows: When a herd is discovered the natives launch their canoe and steal cautiously towards it. If the animals are asleep, every effort is made to approach them without waking them, for, in that manner, they may easily be speared, when they are almost invariably captured, whereas, when they are shot, they are so liable to sink to the bottom before the canoes can reach them that many valuable skins are lost.

The Victoria seals are captured at an earlier date than the Alaskan seals, and they are chiefly females and old bulls. The Copper Island seals are taken on "Copper Island," one of the islands of the Aleutian group, which is still the property of Russia. Their fur is inferior to Alaskan seal, however, in spite of the fact that it is generally believed that it is the same animal but taken at a different season of the year. It is lighter in color, being of a dark brown hue, and is generally inferior in quality. At the same time from 40,000 to 50,000 of these skins are taken annually.

According to the decision of the Bering Sea Court of Arbitration, announced at Paris, 15 August 1893, a close season was established to begin 1 May and to continue until 31 July, these restrictions to apply both in the north Pacific Ocean and in Bering Sea. A protected zone was also established extending for 60 miles around the islands, Pelagic sealing being allowed in Bering Sea, outside that zone, from 1 August. The use of firearms in sealing was forbidden.

In spite of all the precautionary measures that were adopted it is generally conceded that the Paris Court of Arbitration was a failure, at least so far as the prevention of the extinction of the seals was concerned. In 1901, Governor Sheakley, in a report submitted to the secretary of the interior, insisted that the extinction of the fur-bearing animals in Alaska was almost inevitable. Speaking of the rapidly diminishing seals, he said that the official inspection of skins taken by the pelagic sealers during the previous year showed anywhere from 55 to 80 per cent of female skins, a condition which merely confirmed previous investigations upon that subject, and he explained that so long as buckshot was being picked from the hides of young males killed in the Pribylov Islands, and maimed and wounded seals still limped about the hauling grounds, to say nothing of the fact that female skins predominated in the pelagic catches that arrived in London, it was unnecessary to make any further investigation as to the cause of the demolition of the seals. In his opinion, there was nothing that could be done at the islands to better the situation, for the rehabilitation of the rookeries would be an easy matter if adequate protection could be afforded the females. In 1902, Henry W. Elliott, the Government's fur expert, sounded a similar warning by assuring the Government that better protection was needed than that which was afforded by the finding of the Paris tribunal, and, about two years later, 9 March 1904, he again appeared before Congress to announce that his worst fears were about to be realized as the killings on the islands had run down to the very dregs of the young male life which the law permitted to be killed. In his 1905 report the secretary of commerce and labor considered this subject quite fully, and recommended that strong efforts be made to secure the necessary international regulations to put a stop to pelagic sealing. It was also shown by figures that, as the result of this wanton destruction of seal life, the herd on the Pribylov Islands had been reduced from approximately 2,000,000 animals in 1885, to about

200,000 in 1905, while the ravages of these pelagic sealers had reduced the number of skins taken from 100,000 in 1885, to less than 15,000 during 1905.

It is not for seal-skins alone that the American fur trade is indebted to Alaska, however, for that territory helps to supply the world with many other pelts including those of the sea and land otter, the brown and black bear, the beaver, fox, mink, marten, lynx, wolf, muskrat, and wolverine. An industry pursued incidentally with that of sealing on the Pribylov Islands is that of raising the blue fox for its pelt. This foxing industry, which is conducted by the agents of the lessee, permits of the killing of the fox under proper restrictions, the catch during the winter of 1904 amounting in all the islands to 289 blue fox skins and 13 white fox skins. Efforts have also been made by the agents of the department of commerce and labor, by the careful selection of the best animals for breeders and an insistance upon an adequate quantity of fox food to be furnished by the lessee, to induce an increased birth rate among these animals. What makes this experiment particularly interesting is that the proceeds from the sale of these skins are applied to the support of the native inhabitants of the islands, their services being required in the taking and curing of all kinds of pelts.

The manufacturing of skins into articles of commerce is not only an industry in itself but one that requires considerable knowledge and experience, as both the durability and the appearance of most furs depend much upon the mode in which they are cured, dried, and made up. To prepare most skins for packing and transportation — after they have been stripped from the animal — they are first carefully cleaned of fat and flesh, and are then dried in a cool, dry place. When thoroughly dry they are ready for shipment. This methid, of course, does not apply to the seal-skin, the manner of packing them in salt having already been described.

To present anything like definite figures regarding the consumption of furs is an extremely difficult matter as the demand for the many varieties vary from year to year owing to the fickleness of fashion. It is also due to fashion's foibles that some of the animals having the most beautiful skins are not exterminated, for when the demand for a certain variety of fur ceases for a season or two, with it ceases the destruction of the animals, which leaves them a period of safety in which they may recover their normal status as to numbers.

The American fur industry, like most other business and professions, is divided into departments and few firms now carry on all the branches of the business, as it was formerly done, under one roof. The taxidermist, for example, has one of the collateral branches of the fur trade. The manufacturing furriers and fur dealers represent an enormous investment of capital, especially those who are large exporters and importers of furs, for, in spite of the fact that London and Leipsic still have a firm hold upon the international trade, there are many fur houses in this country that conduct constantly increasing operations with the foreign markets owing to the superiority of American manufactures in furs. In addition to these, however, there are many other branches that are more or less directly connected with the fur industry. Among them one may mention the manufacturers of hats and caps, jobbers of furs, dealers in hatters' furs, proprietors of skunk and other fur farms, fur sewing machine houses, and firms making machinery and materials for the use of furriers, such as muff-blocks, head-forms, skulls, and down muff-beds. According to the 1900 census the aggregate number of establishments handling fur goods in the United States was placed at 994, but these firms paid $5,315,584 in wages to 9,709 employees. The cost of materials used during the census year amounted to $15,742,508, while the value of the product manufactured, including the receipts for custom work and repairing, amounted to more than $27,735,264. The total domestic exports of furs and fur skins during the year 1905, amounted to $6,599,222, while the imports of furs and fur skins, undressed, during 1905, were $10,502,907. The following table gives the value of the imports and exports of furs and the manufacturers of furs in this country from 1880 to 1905, inclusive:

FURS AND MANUFACTURES OF FURS.

Year	Imports	Exports
1880	$ 6,424,112	$5,404,418
1885	5,257,547	4,153,287
1890	7,553,816	4,661,934
1891	9,828,849	3,236,705
1892	10,197,131	3,586,339
1893	10,567,807	3,699,579
1894	7,620,284	4,238,690
1895	10,322,157	3,923,130
1896	9,303,398	3,800,168
1897	6,015,104	3,284,349
1898	7,881,172	2,986,970
1899	10,861,262	3,092,846
1900	12,060,124	4,503,968
1901	11,019,658	4,404,448
1902	15,623,601	5,030,204
1903	15,301,912	6,181,115
1904	14,763,002	5,422,945
1905	18,306,302	6,599,222

Furies, Eumenides, or **Erinyes,** called by the Romans FURIÆ and DIRÆ, were Greek mythological divinities, the avengers of murder, perjury, and filial ingratitude. They sprang from the drops of blood which fell from Uranus when he was mutilated by his son Kronos or Saturn. Others make them the daughters of Acheron and Night, and of Pluto and Proserpine. Later mythologists reckon three of them. and call them Alecto the unresting, Megæra the jealous, and Tisiphone the avenger. They were supposed to be the ministers of the gods, and to execute their irrevocable decrees; their sphere of action consequently was both in the infernal regions, to punish condemned souls, and on the earth to rack the guilty conscience and chastise by mental torments. Æschylus, in the celebrated tragedy of the Eumenides, introduced 50 furies, and with them Horror, Terror, Paleness, Rage, and Death, upon the stage. These terrible beings were described as clothed in black robes, with serpents instead of hair, with fingers like claws, a whip of scorpions in one hand and a burning torch in the other, an outstretched tongue, and eyes dripping with gore. They were suckers of the blood of men; when they were enraged, a venom oozed from them that spread like a leprosy-spot wherever it fell,

and made the ground barren. They were regarded with great dread, and the Athenians hardly dared to speak their names, but called them the *venerable goddesses*, by a similar euphemism the name Eumenides, signifying the soothed or well-pleased goddesses, being introduced. They dwelt in the cave called after them, at the northeast corner of the Areopagus at Athens, below the seats of the judges. Erinyes, the more ancient name, signifies the hunters or persecutors of the criminal, or the angry goddesses. The sculptors represented them as beautiful hunting nymphs, whose character was indicated only by the sternness of their expression, by the torch, dagger, and other similar emblems.

Furman University, a coeducational institution in Greenville, S. C.; founded in 1854 under the auspices of the Baptist Church. Reported in 1901: Professors and instructors, 15; students, 217; volumes in the library, 2,000; productive funds, $65,000; grounds and buildings valued at $80,000; benefactions, $25,000; income, $37,500; president, A. P. Montague, LL. D.

Furnace, a structure wherein a vehement fire and heat may be made and maintained, as for melting ores or metals, heating the boiler of a steam-engine, warming a house, baking pottery or bread, and other such purposes. Furnaces are constructed in a great variety of ways, according to the different purposes to which they are applied. In constructing furnaces the following objects are kept in view: (1) To obtain the greatest quantity of heat from a given quantity of fuel. (See FUEL.) (2) To prevent the dissipation of the heat after it is produced. (3) To concentrate the heat and direct it as much as possible to the substances to be acted on. (4) To be able to regulate at pleasure the necessary degree of heat (see HEAT) and have it wholly under the operator's management. An air furnace is one in which the flames are urged only by the natural draught; a blast furnace, one in which the heat is intensified by the injection of a strong current of air by artificial means; a reverbatory furnace, one in which the flames in passing to the chimney are thrown down by a low-arched roof on the objects which it is intended to expose to their action.

Those furnaces in which gaseous fuel is burned form a class of considerable importance. The gas to be consumed and the air to be used in the combustion are introduced into the combustion-chamber by separate pipes or openings, preferably in parallel streams near to each other, or in opposite directions along one channel so as to mingle before entering the chamber. The fuel may be either some naturally occurring gas, or one specially manufactured for the purpose, or the by-product of some other industrial process, for example, the waste gases of the blast furnace. Four methods of preparing fuel gases are distinguished: dry distillation, as in the case of coal-gas; preparation from oils; the producer method; and the water-gas method. Producer-gas was first introduced by Siemens. Regenerators are furnaces in which the gaseous fuel and the air to be mixed with it are heated before combustion with a view to increasing the working temperature of the furnace. The advantages of gas furnaces may be briefly summarized thus: no ashes or slag, high temperature, certainty of action and capability of exact regulation, simplification of working power, comparative cheapness, and economy. The electric current has been successfully utilized in the production of heat for chemical and metallurgical operations, and in this way temperatures otherwise unattainable have been reached. See ELECTRIC FURNACE; GAS; GAS, NATURAL.

Furnaces, Electric. See ELECTRIC FURNACES.

Furnaces, Metallurgical. See METALLURGY.

Furneaux (fėr nō') **Islands,** a group in the South Pacific off Tasmania, to which colony they belong. The total area is about 1,050 square miles. The principal islands are Flinders, Cape Barren, and Clarke. The inhabitants number about 700, and earn their livelihood by seal-fishing, the capture of sea-fowl, etc. The islands were discovered in 1773 by Tobias Furneaux (q.v.).

Fur'ness, Horace Howard, American Shakespearian scholar and editor; son of William Henry Furness (1802-96) (q.v.): b. Philadelphia 2 Nov. 1833. He was graduated at Harvard in 1854; studied law, and was admitted to the bar in 1859. The honorary degree of Ph.D. was conferred on him by the University of Göttingen in recognition of his services to Shakespearian literature. He is the editor of the exhaustive 'New Variorum Edition' of Shakespeare, the successive volumes of which appearing since 1871, include: 'Romeo and Juliet' (1871); 'Macbeth' (1873); 'Hamlet' (2 vols. 1877); 'Lear' (1880); 'Othello' (1886); 'Merchant of Venice' (1888); 'As You Like It' (1890); 'Tempest' (1892); 'Midsummer Night's Dream' (1895); 'Winter's Tale' (1898); 'Twelfth Night' (1901).

Furness, William Henry, American clergyman and author: b. Boston, Mass., 20 April 1802; d. Philadelphia 30 Jan. 1896. He was educated at Harvard; studied theology at Cambridge, Mass., and was pastor of the First Unitarian Church in Philadelphia in 1825-75. He was an earnest supporter of the anti-slavery movement and was a German scholar of eminence, translating much from the German in both prose and verse. He was a radical in his religious views but made a life study of the character of Jesus, which forms the theme of several of his works. Among his numerous works are: 'Remarks on the Four Gospels' (1836); 'Jesus and His Biographers' (183[illegible]); 'A History of Jesus' (1850); 'Thoughts on the Life and Character of Jesus of Nazareth' (1859); 'The Veil Partly Lifted' (1864); 'Jesus' (1871); 'Verses and Translations from the German Poets' (1886); 'Pastoral Offices' (1893).

Furness, William Henry, 1828–67, American artist, son of the preceding: b. Philadelphia, Pa., 21 May 1828; d. Cambridge, Mass., 4 March 1867. He very early made a reputation by the excellence of his crayon portraits, and having earned from the sale of these the means for foreign travel, studied art in Europe for two years. On his return to America he established himself as a portrait painter in Philadelphia, and subsequently in Boston, and at the time of his death was one of the foremost portrait

painters in the country. Among noted portraits by him are those of his father, Dr. Furness; Charles Sumner, and Lucretia Mott.

Furness, William Henry, 1866, American ethnologist: b. Wallingford, Pa., 1866. He is a son of H. H. Furness (q.v.), and was educated at Harvard and the medical school of the University of Pennsylvania. He has published: 'Folk-Lore in Borneo' (1899); 'Life in the Luchu Islands' (1899); 'Home Life of the Borneo Head Hunters: its Festivals and Folk-Lore' (1902).

Furnishing Goods. See CLOTHING AND FURNISHING TRADE.

Furniture, formerly all the various movable appliances or articles in the interior of a house, now more commonly applied to articles of wood or metal. The ancient Egyptians aimed to variety rather than symmetry in the arrangement of their houses. They had chairs made of the finest woods in great variety of design, covered with rich cloths or skins, and inlaid with gold or ivory. They also used folding stools, sofas, couches, and carpets or rugs. Their tables were of variety of shapes and constructions. Bedsteads were made of wicker-work and sometimes of bronze. The forms of household articles of furniture found in or represented on Assyrian monuments and remains, show great artistic elaboration and a profusion of highly wrought ornament. The Assyrians were especially skilful in the chasing of metals, and they delighted in reproducing natural objects on their ornaments. The Greeks had couches covered with skins or drapery, on which several persons might lie with their bodies half raised; these were used at meal times by the men only, women and children sitting on seats; they had large armchairs with footstools, portable small chairs without arms, and stools with carved legs made to fold up.

Among the Romans, Greek art gained a predominant influence, and the conquerors of the world were at all times glad to employ natives of Greece to design and execute the works intended to display the opulence of their masters. On the ornaments of the *triclinia* or couches on which they repose, immense sums were bestowed. They were often inlaid with precious materials, such as ivory, tortoise shell, gold and silver, and had ivory or metal feet. They consisted of a framework which was strung with girths, on which rested a mattress stuffed with straw, wool, or feathers, and covered with rich drapery. The *lectus cubicularis*, or bed, was higher than the couch, but not unlike it. The tables were generally of costly foreign wood, resting on frames of carved marble or an ivory column. The curule chairs, or seats of state of the patricians and magistrates, were wrought in ivory; and to form an estimate from the number of beautiful utensils in marble and bronze richly chased and inlaid with silver, that have been found in the ruins of a comparatively insignificant city, Pompeii, the wealth of the Romans in movable property of this nature must have been very great. The library first appears as a separate apartment in a Roman house; that discovered at Herculaneum was small, and lined with presses about the height of a man, in which the rolls of papyrus and parchment were kept. Still, according to modern ideas, the Roman rooms would seem rather bare of furniture. They had no writing tables or cabinets; couches, chairs, tables, and candelabra comprised the whole of the furniture with the exception now and then of a water clock, or a chafing dish.

Among European states from 500 A.D. to 1500, the ecclesiastical style prevailed in furniture as in every other species of art, attaining its greatest eminence in the decorated Gothic of the 14th century. Articles of furniture previous to 1500 are very rare. For three centuries after the Conquest domestic furniture was very scanty. The hall was furnished with tables and benches, the furniture of a bedroom consisted of little more than a bed and a chest. Chairs were large and cumbrous, and were usually fixtures; wooden forms, sometimes with black rails, being placed against the walls. The furniture of the dining-room was very limited. Boards on trestles were in general use as tables. In the 14th and 15th centuries remarkable progress was made and a considerable degree of splendor in furniture was attained. Defense began to be not the only object studied in the construction of buildings. The Gothic paneling of the carved bedsteads, chairs, screens, etc., was dazzling with scarlet, blue, and gold, and costly embroidered hangings and curtains heavy with heraldic symbolism, cabinets, reading-desks, prie-dieus, ivory and enameled coffers, fire dogs, or andirons elaborately chased and gilded, began to appear.

The progress of this decorative style was suddenly arrested by the «Renaissance,» or revival of ancient classical art and literature, of which Italy was the earliest seat, and from whence the impulse was given that communicated itself speedily to the rest of Europe. A genuine and self-evolved style instantly went out of fashion, and was discarded for an imitation and counterfeit one based on the copying of understood classic models which were applied without consideration to the most incongruous objects. The classical temple was the dominant idea in the manufacture of furniture as well as in the construction of a palace or a cathedral, and columns were considered as necessary in one species of art as in the other. All the architectural details of Roman buildings were then applied to furniture; the lions, griffins, chimeras, etc., of the temple frieze encumbered the stately pillars of the Italian palaces, and caryatides and Roman trophies replaced the patron saint and the crucifix. With all its absurdities, it must be noted that this style was in the hands of great men, and their productions display a boldness and vigor of line, and a mastery over human and animal forms that give dignity to a licentious freedom of design in which all appropriateness is forgotten. Specimens of the Renaissance are still met with, though daily increasing in value. Gothic art never recovered its lost ground.

With various modifications the Renaissance style continued dominant for nearly two centuries. In England it degenerated into positive ugliness, the furniture of the time of Elizabeth and James I. having very little to recommend it in tasteful design. It is distinguished by a mixture of overwrought heavy molding, combined with thin spindly columns, twisted legs, and other inelegant characteristics. Magnificence is sometimes attempted in the value of the material, as in the famous set of chamber fur-

niture in chased silver executed for a royal visit at Knowle Park, the seat of the dukes of Dorset in Kent. It was succeeded by the style named after the French monarch, its patron and encourager, Louis XIV.

The modern predominance of France in the construction of furniture is owing to the minister Colbert. He it was who brought together the best workmen of Europe, and by an edict of the year 1667 established the French royal manufactory of furniture. The new style which the productions of this establishment assumed appears to have been worked out undesignedly, and, like every such successful phase of art, was the genuine product of circumstances. Novelty and magnificence seem to have been the great features aimed at; these were sought by varied treatment of surface in cabinet furniture (as inlays of metals, ivory, enamels, porcelain tablets, tortoise shell, etc.), and by an incrustation of broken scroll panel work, which hid the real constructive forms and frittered away the graceful outlines of the Renaissance into a confused and unsymmetrical mass. Under Louis XV. the same school of art continued, and it received new elaboration under the successors of Boule, Riesner, and Gouthier; their works are known to connoisseurs as articles of vertu by the respective styles of each master, and fine specimens bring almost fabulous prices. Probably more of this class of furniture is to be found in Great Britain than in all the rest of Europe, a great change of owners having been brought about by the French Revolution. While the splendid extravagances of Louis XIV. were holding sway in France, the prevailing taste in England seems rather to have been modified by the fashion introduced from Holland by William III. The native woods, oak or wainscot, chestnut, etc., were about this time superseded for furniture by the dark and heavy West India mahogany, the invariable material of the ill-designed and awkward furniture familiar to us in the immortal designs of Hogarth. A better style based on that of France was introduced by Chippendale, but a severer and more artistic taste was displayed by the designs of Heppelwhite and Sheraton. In the latter part of the reign of Louis XVI. another change is apparent in French furniture. Greece and Rome were looked up to as standards of correctness in furniture as well as in politics. But instead of impressing their own genius on designs inspired by ancient models as did the great artists of the Renaissance, the authors of this revival were too often content with frigid imitation. The classical style did not long hold sway, and since that time the practice of both France and England (and with them the rest of Europe) has been purely eclectic. At present designs after the best work of the older makers are much in favor in both Europe and America. See Furniture Industry in America, The.

Furniture, Colonial. When the Colonists first landed, and during their early struggle for existence, little if any attempt was made to import furniture, and we have nothing now which could be rightfully claimed to have been brought over from Europe before the coming of the Mayflower (1620). The New Englanders were the first to make furniture copying the designs of the original pieces, which were of heavy oak with severe lines and flat carvings. Their puritanical minds apparently abhorred anything of an ecclesiastical cast. As early as 1650 the southern planters imported fine pieces from England, of oak richly carved and inlaid, the designs being influenced by the Renaissance just dawning in France, and the Elizabethan and Jacobean periods in England. The authorities in the South tried to prevent trade with Holland and New England, so a comparison of the English furniture, prior to the Revolutionary War, with that of Maryland and Virginia, shows that the English life of that time was planted there as far as it was possible. Since we find so few of these original pieces, we can only think that the planters becoming wealthy so rapidly, and wishing to keep up to the "prevailing English style," must have discarded the old for the new, as their invoices show large importations of furniture up to the Revolutionary War.

There was a marked difference between the houses of New York and of New England. The Dutch built theirs of brick, while those in New England were mostly of timber, and a striking feature in the living-room of the former was the chimney-piece, which among the wealthy was elaborately carved and tiled and held vessels of brass repoussé and Delft-ware. The fire-place with its colored tiles continued to be a decorative feature, even after coal succeeded wood as fuel and grates took the place of andirons. The floor of the average house was sanded, and rooms had no special character. The ideas which the Dutch brought from the Orient influenced the designs not only around New York but in New England as well, and fast grew into favor. Strange shapes from the East, introducing marqueterie in exotic woods, were eclipsing the old chests of drawers, cupboards, etc., and actual products of the Far East filled many of the Dutch houses. The cabriole legs superseded the severer lines. Other woods beside oak, such as walnut, pine, red cedar, maple, etc., were introduced; ebony was scarce, so the "black egg ornament" was often of white wood stained black.

In the first half of the 18th century New York was an important place, and inventories show that fashions in New York compared favorably with those of London and Amsterdam. The bed was disappearing from the hall; carpets were introduced, and in 1750 they had flowered carpets and "painted floor cloths." The walls, of houses of the better class, were papered before the middle of the 18th century, and for 50 years we have an interesting wall-paper period; their chief designs were large illustrating panels, such as "The Lady of the Lake," "The Four Seasons," etc. Fire-places were growing smaller as wood was harder to obtain, and in 1745 Franklin invented what is now known as the "Franklin stove." Upholstery was taken up and there were many cabinet-makers in New York, Boston, and Philadelphia; skilled workmanship was in demand, and "choice timber and metal furnishings for cabinets" were advertised. Then came the period when mahogany was the favorite wood, and, just as in England, all designs had a tendency toward greater lightness and grace of line, and showed the Chinese influence strongly. In 1776 the home of a wealthy Amer-

ican compared favorably with that of an Englishman in similar circumstances. "Chippendale" was the rage, both imported and domestic. There was a marked difference between the North and South — the Northerners lived more simply, but with a certain amount of fashion and elegance; in the South everything was ease and luxury, and many houses were noted for their costly furnishings. Around Charleston, S. C., at the present time are some excellent examples of typical Southern homes of the 18th century, containing many of the original pieces of furniture. The classic or Greek style adopted by Adam in England, found its way here, and was seen in architecture and interior woodwork, noticeably in mantels and built-in cupboards, but was little used in articles of furniture.

Mt. Vernon — now a museum of relics — is the most interesting colonial house, on account of its associations. It was inherited by George Washington in 1751 from his half-brother Lawrence Washington. Soon after it was almost entirely refurnished, and though by no means palatial was extremely comfortable. There were few of the original Washington pieces left there, as Mrs. Washington bequeathed the furniture to four grandchildren, but now many articles are gradually finding their way back, either through gift, or through purchase by the Mt. Vernon Ladies' Association of the Union. There are many Washington pieces, used by him while in Philadelphia, now in possession of the Historical Society of Pennsylvania. Second in interest is Monticello, the home of Thomas Jefferson. Its architecture and decorations are delightful, and it still contains proofs of the owner's good taste and love of art.

"Colonial designs," as termed in the vocabulary of the dealer of to-day, were not known until the colonies had become States. They are traced in America first through the Dutch, who had taken many points from Spain and the Orient, namely the ball and claw pattern. Chippendale adapted them with more lightness and grace of line, but the French Empire style which came in at that time changed it into the massive mahogany, and gave the rope-carved pillars and lion-claw feet. American makers omitted the elaborate brass and ormolu trimmings used by the French, and depended upon the beautiful grain of the wood, often veneering to obtain handsome effects. The superiority of the old furniture is due to its construction; the old makers worked solidly, dove-tailing, and blocking all drawers, and to-day the age of the wood has greatly added to its value, the stained mahogany loses the beautiful golden shafts of light. The polish was attained by constant rubbing, while to-day most pieces are simply varnished.

Mahogany was brought into England by Sir Walter Raleigh, but was not in general use until about 1725. In New England it was extensively used a little later, being imported from the West Indies. The Honduras and Mexican varieties most commonly used to-day, do not materially improve with age, and are much lighter in weight than the West Indian, therefore a really old piece may often be told by its heaviness. The date of a bureau, chest of drawers, etc., may frequently be ascertained from its handles.

Handles.— The oldest handles, chiefly brass, rarely pewter, were drop-handles, formed like an earring, backed by a small plate. Next in order was a larger plate, usually engraved, with a bail large enough to insert two fingers. The next was a larger plain plate similar to a fleur-de-lis in shape, the bail being much larger, and from now on, held into the drawer by brass nuts instead of wires as formerly, but in reproductions iron nuts are nearly always used. It gradually developed into a thin oval plate embossed with moldings, sometimes with centre design, and the bail, fitted into posts, falls outside the plate, preserving the same curve. Still later came the knob and empire rosette handles, sometimes with ring, usually of brass but also of glass or plain wood.

Chests.— No matter how meagre an inventory, it always included a box, chest, or case. First the ordinary ship's chest of pine with iron handles, which was appraised very low. There are several good examples of these in State historical societies, including one brought over in the Mayflower. Few of these were made after 1725. The oldest carved chests were in low relief with often the date and name of the person for whom it was made; they were afterward made with one drawer, having panel or turned ornaments. This developed into the "chest of drawers," made of oak and more elaborately decorated, which in turn developed into the "chest upon chest," sometimes having as many as nine drawers, and the three-tier "steps" for displaying china was sometimes placed upon these. The "high-boy" is not mentioned until the chest of drawers was placed upon a frame about three feet high, having one or more drawers; it had six legs, and later the part where the centre legs were omitted was finished with "drops." This, in the latter part of the 18th century, became a very handsome article of furniture, with carved top, usually "shell" or "sun" pattern, decorated with gilt torches or balls, and cabriole legs and carved feet.

The Dressing-Table, or "low-boy," came from England in 1716. At first it had but one drawer, afterward it was the same as the frame for the "high-boy," only about three inches lower. The "high-boy" and "low-boy" were often made to match. The Chippendale and Sheraton designs were usually furnished with dressing-boxes and mirror.

The Settle was an evolution of the chest. Handsome examples are rarely found in this country, although there are many varieties of the "fire-side" settle in painted pine and oak found in New England, with a shelf to hold a candle. The settles which appeared in the latter part of the 18th century, following the Chippendale, Sheraton, and Heppelwhite designs, might better be termed sofas, which later took on the Empire designs, with "claw-and-ball" and "wings-and-claw" feet, and "cornucopia" and "swan-neck" ends.

Beds were among the first and most frequently mentioned articles of furniture in wills, being highly prized. In the 17th century the Southern planters owned elaborate European bedsteads, usually of oak. In New England they were very simple affairs, while among the Dutch the bed, at first, was only a sort of bunk. The four-poster soon supplanted all, first of oak, but later of mahogany. Some were most elaborate, with rope-carved, or pineapple and acanthus-leaf posts, and ball-and-claw feet, with

1–5. Handles.
6. Dressing table.—Constitution mirror.
7. High-boy.
8. Windsor chair.
9. Four-post bed.

tester drapery, valance, curtains and coverlet to match, of white or bright colored materials, chiefly drugget, lindsey-woolsey, or dimity, though later chintz was popular. In the South, mosquito canopies were prevalent, sometimes colored to match the color scheme of the room. Feather beds were universally used, resting on ropes or sacking pulled taut, and owing to their height, "bed steps" were necessary. We also find mention of turkey feathers and cat-tails being used as fillings, and early in the 18th century hair mattresses appeared.

Cupboards were usually built into the wall, and whether called "livery," "court," "standing," or "press," were all fitted with light movable shelves to hold linen and display china and glass. There are few of these open cupboards to-day. First the upper part was enclosed with doors (later ones show glass doors with lattice work), afterward a drawer was added, then the lower part was enclosed, and when fitted with lock and key was highly prized as an article of furniture. These partly opened cupboards were called "beaufait," afterward contracted to "boufet." Closed-in cupboards show German as well as Dutch origin, and the finest examples were found among the Dutch, usually spoken of as "kasse," carefully carved and painted.

Chairs are scarcely mentioned before 1650, forms or benches being used almost entirely, the chair being considered the seat of honor, but toward the end of the century there was a marked increase in the numbers mentioned in the inventories. They were made of oak, pine, and walnut, turned or paneled, simply carved and with high backs, the seats either rush or cane. About the 17th century we notice leather and "turkey-work" seats with brass nail-heads. The "ball-and-claw" foot, introduced by the Dutch, appeared at the close of the 17th century and remained in favor for nearly a hundred years. Chairs made of wicker and cane were known as early as 1711, and in 1720 came the painted chairs from Holland, usually black, often decorated, with rush or cane seats. The Windsor chair, first made and used in Philadelphia in 1725, was the most popular style up to the 19th century. It was usually of hickory or ash and had a wooden seat, the back was high and either "spindled" or "fan-shaped," sometimes having an extra headpiece. The style known as Chippendale appeared in 1720, the development being apparent before Chippendale worked. Its chief characteristics were the traceried splat, bow-shaped back and cabriole legs, also the "plate-backed," which was a solid splat, usually jar-shaped, and hoof feet. The all-upholstered "wing" chair seemed to be in general use before 1750. Mahogany was now easily procurable and the tendency was toward greater lightness, and most of the designs, from now on, follow the English cabinet-makers; Chippendale, with a strong Chinese influence, then Sheraton and Heppelwhite, some being beautifully decorated with hand-paintings, carvings and inlay. In 1770 we have another style, modeled after the old "splat-back," but with the splats crosswise. About 1800 the style commonly known as "empire" began to be felt, and gave us the "lion" and "bear" claw-feet and rolling backs, copied after old Egyptian designs. The strong empire was partially modified here by the Sheraton influence. There is a style in America, a modification of the empire, with heavy mahogany splat-back, usually jar-shaped, often having the back and back legs in one piece. These were in favor until 1840; they were usually covered with "horse-hair" and are now offered as "Colonial" designs!

Tables.— What has been said of the development of chairs may be applied to tables, as almost every form of chair had its corresponding table. First we had the "table-borde," a board, often 12 feet long by 2 wide, resting on a cross-legged trestle. It gradually became customary to leave the "borde" on the trestle instead of removing it after each meal, and it was then known as a table. Marble and slate-topped tables appeared about 1693, and were considered "the latest thing." Before the 18th century we had imported "chair-top" tables, "drop-leaf," and the "100 legged," which was the first extension table, all with turned posts. About 1735 the Dutch influence was strong, and to-day we have some excellent examples, dating from 1750, of mahogany "pie-crust," "dish-top," etc. The "centre-pillar" table came in with the Empire period. Tea tables were found in every parlor of the 18th century, always ready with complete tea-service, spirit-lamp, kettle, tea-box, tongs, strainer, etc. Among the Dutch the table was frequently of rare or japanned woods, many with adjustable tops. Card tables, of which there were many, usually had a plain surface, though some were covered with green cloth; they had folding tops and corner shallows for counters. Work tables were mostly of Sheraton design, the top lifting up, disclosing compartments for sewing materials. Candle tables were of various heights, with a top only large enough to hold a candlestick.

Desks.— A desk was originally a wooden box with slanting lid, the writing materials, and frequently the Bible, were kept inside under lock and key, and the top served the double purpose of reading and writing desk. The large desk or "secretary" appeared about 1660 and seems to have been another development of the "chest of drawers," usually having two or more drawers in the lower half. The lid on the upper part was either let down on chains or rested on two wooden slides. The interior was fitted with many drawers and pigeon-holes, and they had often secret compartments. Later, a cabinet was placed on top and developed into the "cabinet-top" desk, made in one piece and reaching almost to the ceiling. The "table-topped" desk belonged to a later period, a good example being the one used by Washington while in New York in 1789, now in the City Hall. There are some good specimens of Sheraton and Heppelwhite desks in this country belonging to their respective periods. The later empire or "Colonial" pieces were large and heavy, mostly "bureau-fronts."

Clocks.— There is slight mention of household clocks prior to 1700, but in the 18th century clock-making was quite an art; the Willard Brothers of Massachusetts were the first to become famous. Around New York were found some "Frisian" wall clocks from Holland, run by weights, with elaborate designs of gilded and painted mermaids, cherubs, etc. The English "lantern" clock was on the same order, being of brass with heraldic metal work. This developed into the "bracket" clock, through having a wooden hood placed over it for protection; it

was very popular about 1700. The first mention of a tall clock is in the latter part of the 17th century, when long pendulums, also moving figures upon the dial, became fashionable. It was spoken of as "clock and case," and was very plain, of oak or walnut but later of mahogany. Many of them were destroyed during the Revolution, the works being hidden and the cases, in some instances, used for shipping bayonets. Few tall clocks were made after 1815. After the Revolution cheaper time-pieces were in demand, and to meet it, clocks having white enamel dials and wooden works were invented. From then on, there were many styles of cheap clocks for walls and mantels, including the "banjo" clock patented by Willard in 1802; the "lyre" clock, and many "Colonial" designs in wood, some with painted glass covering the pendulum.

Looking-Glasses.— The first record is in an inventory in Maryland 1639. They were rare at that time even in England, being imported from Venice. The frames were of olive-wood, black or gilt, and when the glass exceeded four feet were made of small pieces joined by moldings. Later the frames were heavily carved and inlaid, but always retained the Italian appearance. We find mention of a parlor in a Maryland house in 1732, "set off with pier glasses." In New England it hung over the mantel-piece and was known as the "chimney-glass," usually ornamented at either side with candle sconces. At the end of the 18th century the shield and oval glasses appeared, showing the influence of the English cabinet-makers, followed by the Empire, with rope-carved pillars, acanthus-leaf and lyre carvings, sometimes having the top partitioned off for paintings. What is known as the "Constitution" mirror did not appear until after 1800; most of them bore the eagle at the top.

Mirrors, during the 17th and 18th centuries, were either of convex or concave glass with elaborate frames, and were frequently used for decoration.

Sideboards came into fashion about 1780, taking the place of cupboards and side tables. They were nearly always of mahogany. First after Sheraton, with inlay, noticeably the "bell-flower" design down the slender legs; later "Colonial" of heavy mahogany with the cupboards extending nearly to the floor, ball-and-claw feet and rounded pillars, similar to the bed-posts.

Washstands.— First called a "bason-frame." Few good examples before the latter part of the 18th century, which were influenced by the English cabinet-makers, and later by the Empire.

Warming-Pans were a necessity, especially in New England. The pan was usually of brass with cover, 14 inches in diameter, with a long wooden handle fastened to the pan by an iron socket. Hot coals were placed in it, and when rubbed between the sheets warmed the beds. They were often decorated with open-work carvings and were quite ornamental hanging beside the fire-place.

Screens were used to protect the face from the heat of the fire, were small, made of embroidery or painted wood, with round or square frame, fastened on a post which could be raised or lowered.

Children's Articles.— We find frequent entries of articles of furniture for children. Cradles, the first one brought over in 1620; high-chairs, also "fenders," to keep the children away from the fires.

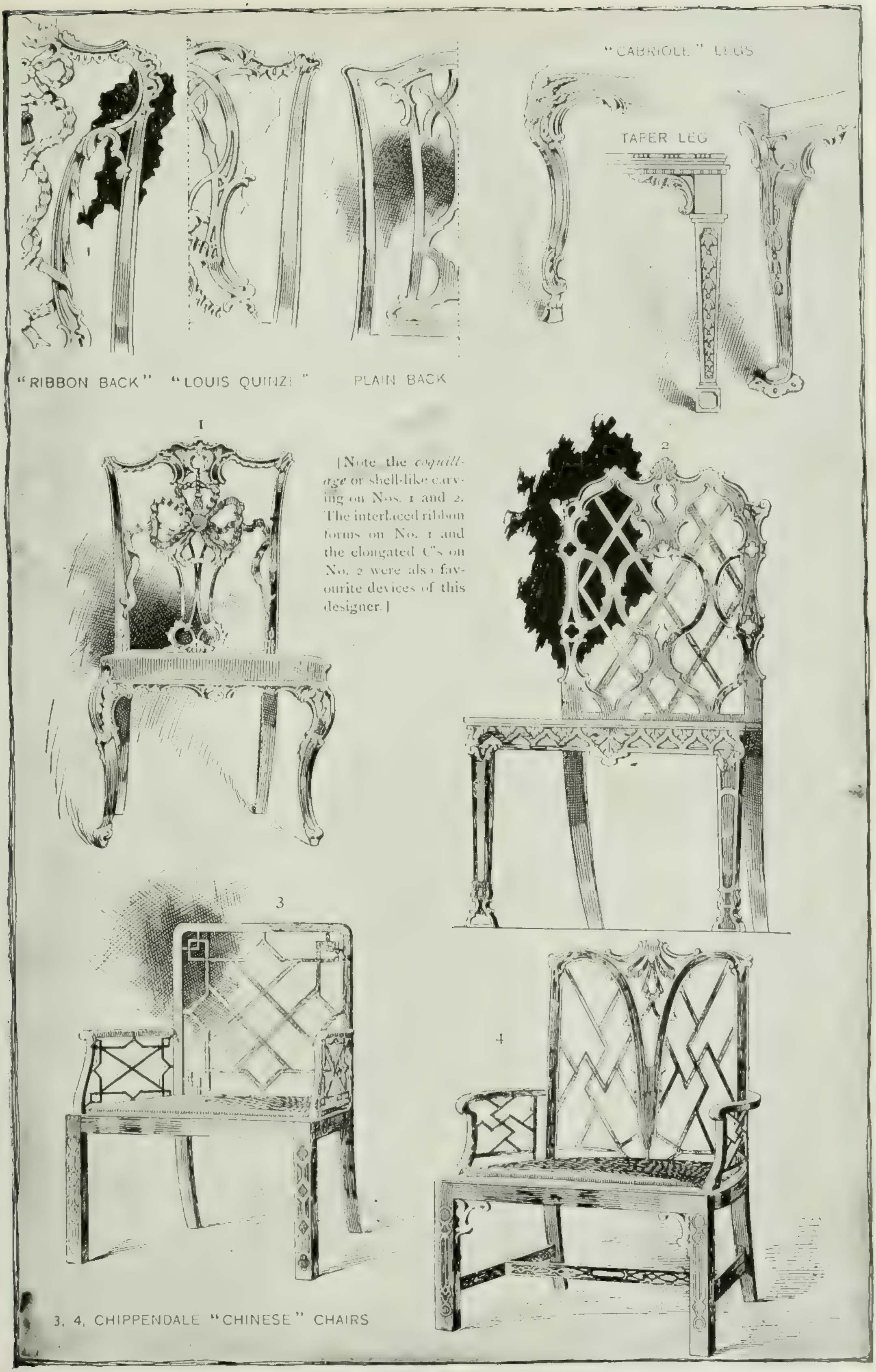
There were several miscellaneous articles of furniture mentioned after 1750, including "dumb-waiters," now called "butler's trays"; "wine-coolers," "knife-boxes," "sewing-boxes," "clothes-trees," etc.

Collections.— Among the many permanent collections of Colonial furniture may be mentioned the Connecticut Historical Society, Hartford, Conn.; the Pilgrim's Society, Plymouth, Mass.; the Essex Institute, Salem, Mass.; Van Courtlandt Mansion, Van Courtlandt Park, N. Y.; American Antiquarian Society, Worcester, Mass.; Historical Society of Pennsylvania, Philadelphia; Washington's Headquarters, Morristown, N. J.; Independence Hall, Philadelphia, Pa.; and Mt. Vernon, Va.

Bibliography.— Singleton, 'Furniture of Our Forefathers'; Lockwood, 'Colonial Furniture in America'; Morse, 'Furniture of the Olden Times'; Wallace, 'Colonial Interiors'; Chandler, 'Colonial Interiors'; Corner and Sodeholtz, 'Colonial Interiors and Exteriors'; and 'The House Beautiful' (monthly).

Louise Cowperthwaite,
Of George C. Flint Company, New York.

Furniture Industry in America, The. The early cabinet-shops of America were like the second-hand repair-shops to be seen to-day in New York, Boston, Philadelphia, and other large cities. A great many cabinet-makers made furniture until late in the 1st century of commercial independence on simple Chippendale lines. Gradually the Empire fashions, which were making themselves felt all over Europe, spread to America, and shapes became heavier and more pretentious, mahogany being used almost exclusively. Heads of animals were also used, and claw-feet became a general feature. Common furniture was heavy and unattractive. The general condition of things at this time was unfavorable to the development of art industries. Little thought was given to progress in the manufacture of furniture and for some years there was a decline. Upon a revival of commerce cabinet-makers changed their style, and began producing a debased rococo style, which did not have the elegance or character of the Louis XV., but was covered with a florid ornamentation in which the only consideration was display. The extravagance of curves and lavish ornamentation brought about a reaction, and toward 1830, following the fashion in England and France, an attempt was made to construct furniture in the Gothic style, but with very unsatisfactory results. The lack of artistic training of the manufacturers who were, as a rule, cabinet-makers or carvers by trade, made it very difficult for them to handle a method of decoration and construction so little appropriate in itself to the requirements of home comfort. This Gothic style of furniture, monumental in appearance, was made to a limited extent only, although its influence is to be noticed on other furniture placed on the market at this time and later. The making of rococo furniture was kept up by a large number of cabinet-makers, the cheaper furniture being for many years made in this style. It was also during this period that steam, applied to cabinet-makers' machinery for



CHARACTERISTIC CHIPPENDALE CHAIR-DESIGNS

Thomas Chippendale flourished about 1750-1760. His "Design Book" was published in 1752.

CHARACTERISTIC HEPPELWHITE FURNITURE

Messrs. A. Heppelwhite & Co., Chippendale's successors, published their "Design Book" in 1789. The Heppelwhites were designers rather than manufacturers.

the first time in 1815, occasioned a revolution in the manufacture of furniture, bringing labor-saving devices into more general use, and enabling the cabinet-maker to supply the rapidly increasing demand for his product. In 1825, Richardson, of Philadelphia, introduced the circular saw, and Taylor, Rich & Company erected the first mahogany-mill in America, a number of these saws being used there. Ordinary furniture, which until now had been very plain, was covered with endless scroll-work and moldings, produced so easily by the new machines. The manufacturers indulged for a time without restraint in this ornamentation. The use of machinery in shops, and the increased facilities for transportation, wrought a wonderful improvement in the furniture trade; and the cabinet-shop, which had until this time been of small importance and partially engaged in making articles kindred to furniture, suddenly assumed large proportions, and confined itself to furniture only, using in the making of it the new devices which were constantly being brought forth by ingenious inventors. The value of the furniture product in the year 1850 may be estimated at about $15,000,000, and the industry gave employment to 37,000 people, out of a population of a little over 23,000,000. For a long time a great number of hand-shops survived, making to order special high-grade work; and they succeeded in impressing their patrons with the idea of the inferiority of machine-made furniture, which at this early stage in the introduction of machinery was not entirely without foundation. The extensive use of machinery in shops had the immediate effect of again changing the style of furniture. Manufacturers looked for a fashion in which they could use their facilities to the best advantage, and at the same time retain the attractiveness of their earlier work. This they found in the Renaissance, which for a number of years superseded all other styles in the best class of furniture.

Up to this time the furniture industry had been confined to the Eastern States, principally in and around Boston; but a number of factories were now started in the West, where situated in proximity to large forests and regions where population and wealth were rapidly increasing, they soon became important factors in the production of furniture in the United States. These factories, equipped with new machinery and using native timber, produced at first a low grade of furniture in which art seems to have been very little considered. Those who wanted more artistic furniture purchased it from the East. The art revival which had taken place in Boston and New York was fostered by increased travel in Europe, where exhibitions were taking place at short intervals in London and Paris. Moreover, the consideration that old furniture was beginning to receive brought forcibly to the people the inferiority of that then made, and manufacturers gave more attention and study to its appearance than before. Trade kept increasing with the general wealth, and in 1860 the production reached $25,500,000; but the number of workingmen employed in this industry, owing to the improvements in machinery, had fallen to 28,000, although the population had then reached almost 31,500,000.

Industries in general were now to receive another blow, on account of the War of the Rebellion. As soon as this conflict was over, the extraordinary activity which had prevailed in military circles was transferred to the industrial field, and from this time on it is by leaps and bounds that improvements can be noted. The furniture trade was in the hands of two classes of manufacturers, one class of whom, having taken the place of the old hand-shop workers made high-class work to order, continuing the old traditions, but now using machinery extensively. The other class of manufacturers studied the wants of the people, and produced suitable articles at prices which were within the reach of the masses. It is to them that we are indebted for the gigantic development of the industry, as they placed within the reach of all, strong, ornamental, and practical furniture. We have seen that men of taste had recognized for some time that our furniture was inferior to that made at the end of the last century, and had begun to study not only the styles of that period, but also those of the English and French prevailing in the past. As a result we find that a great variety of styles were employed in the productions of the leading firms, who were always striving for novel effects.

A work published in London, England, in 1868, entitled 'Hints on Household Taste,' by C. Eastlake, waged war on modern work, advocated returning to the primitive principles of Gothic construction; and gave positive instructions as to what was right or wrong, not only in the line of furniture, but in draperies, carpets, and other household decoration, as precisely as if the art had been a science. This book was looked upon as a sort of gospel treatise on furnishing, and however much we may at this time ridicule some of the ideas conveyed, it directed the public mind in its search for more artistic surroundings at home. From that time other styles were discarded, and designs in accordance with the newly developed taste took their places. The movement in favor of more perfect construction and the use of straight lines exclusively became general, the stiff appearance being relieved by an abundant use of arches, spindles, turnings, etc. This style allowed the manufacturers to do the greater part of the work by machinery, for which it seemed specially adapted. The increased interest that the public took in furniture developed the trade in an unprecedented manner, the production for 1870 being $68,500,000, or nearly two and one half times that for 1860. The number of men employed at this time shows a similar increase, being 55,800, out of a population of 38,500,000 people. The Centennial Exhibition in Philadelphia (1876) had a far-reaching influence, especially on western manufacturers, who until this time had not had occasion to compare their products with those of the best manufacturers of America and Europe. This exhibition marks the highest point that the Eastlake or early English was to attain. A number of the most prominent manufacturers of this country had their exhibits made in this particular style. It was quickly taken up by the manufacturers of cheaper furniture, who until then had given very little attention to artistic form, and they are responsible for the enormous quantity of furniture in imitation of this description that can yet be seen in the auction-rooms of large cities. The strife for originality, which was soon to be one

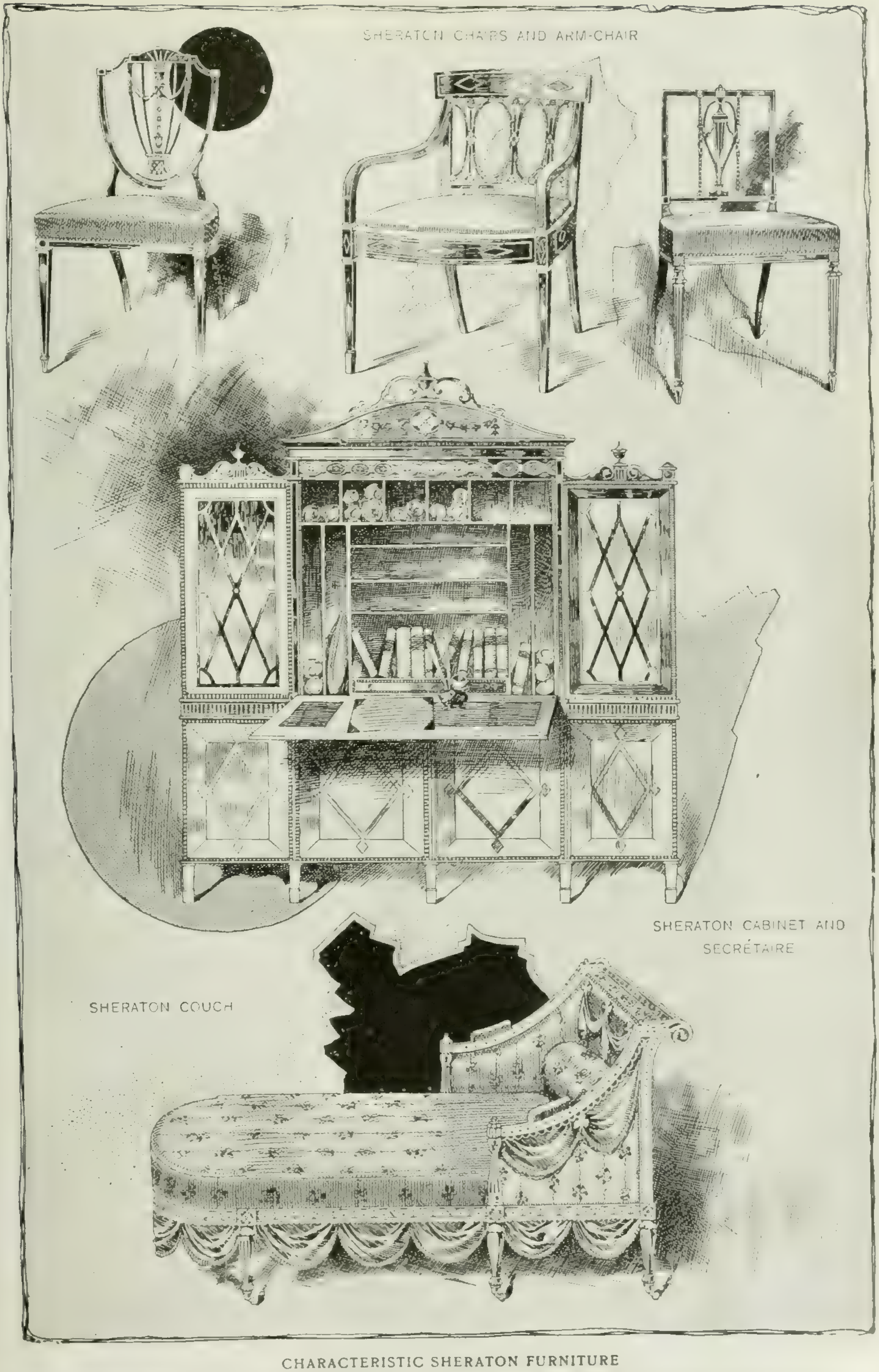
of the characteristics of western manufacturers, had now begun to show itself; but an insufficient knowledge of art subjects rendered many of their designs more strange than beautiful, and more noticeably so when they were working on the lines of any given style; but through diligent efforts their designs were steadily improved, and this, in connection with their superior facilities, has secured to them a large part of the eastern trade. The volume of business showed a substantial increase during this decade, although not as large as during the preceding period. The value of the output of furniture for 1880 was $77,845,000 — an increase of 13.5 per cent in value, but a decrease from $1.77 to $1.55 per capita of the population. The wonderful changes which occurred in architecture in the next decade, especially the Romanesque revival due to H. H. Richardson, had a distinct effect on furniture. Richardson himself designed some Romanesque furniture. Furniture manufacturers eagerly welcomed this departure, for the ceaseless demand for new things, as strong then as it is now, obliged them to change their patterns very frequently. Unfortunately, by passing through the hands of manufacturers of cheap furniture, it lost all of its original beauty. During this decade great improvements were made in woodworking machinery, and a large number of new devices were invented. Among them was the carving machine, which enabled manufacturers to ornament even the cheapest kind of furniture. The amount of business done in 1890, large as it was, did not keep up with the increase of population. The value of the product in 1890 was $86,362,685, an increase of 11 per cent over that of 1880; but the amount per capita of population dropped to $1.38, as compared with $1.55 in 1880, and $1.77 in 1870. The International Paris Exposition of 1889 revived a taste for the 18th century furniture, especially of the Louis XV. style, which was quickly taken up by the people of the United States. In spite of the seeming difficulty of using machinery in making such work, American manufacturers made and are still making a large quantity of furniture, in that dainty mode, which certainly equals that of the same class made in Europe, and is generally better constructed. All the 18th century styles, French or English, have been and to a certain extent are now used by American manufacturers:— Louis XV., Chippendale, Louis XVI., Sheraton, Hepplewhite, Empire and the Flemish Renaissance.

Since the decline of the Empire style in the first half of the last century manufacturers have been satisfied to copy the styles of the past, with such modifications as conformed to commercial requirements. The public demand for reproductions of old furniture increased to such an extent as to leave little room for originality in their production. Within recent years a strong feeling has developed that the old styles are not in keeping with present ideals and new styles should be evolved to emphasize simplicity of construction, grace of style, beauty of proportion and harmony of color. The Mission style, at first heavy and shapeless, is acquiring more subtle and refined lines, thereby increasing in public favor. The novelty of the last century is a free natural style called Art Nouveau. Its introduction to this country from France a few years ago was attended by failure. The market was flooded with goods of inferior make in which the vagaries of this style were mistaken for its distinctive features. The meaningless curves and coarse ornaments of the beginning are being discarded and a refined elegance is now taking their place. The extensive adoption of this style in other art industries warrants the belief that it soon will be a distinctive feature in furniture.

Many of the numerous articles of furniture manufactured are distinctly American. The bureau, the rocking-chair, the folding-bed, the chiffonier, as now made with toilet, and in general most of the combination pieces of furniture made with a view of economizing space in apartments in large cities, are of this class. The American bureau is a combination of the old chest of drawers and the dressing-table, having the drawer-room of the one and the swinging mirror and table-top of the other. This has been imitated in Europe to a limited extent, in the production of what is known as the English dressing-table. As made in this country, the bureau is one of the most practical pieces of furniture used. The rocking-chair, almost entirely unknown in Europe, is found in every home in this country, yet it is difficult to ascertain when it was first put in use. We do not find any mention of it in the descriptions of articles of furniture in the 18th century. The first patent issued for improvements in rocking-chairs is dated as far back as 1830. The folding-bed, in the shape of a sofa, with a box-seat for bedding, has been used in Europe for over a hundred years, but America claims the folding-bed in other forms, such as the wardrobe, the cabinet, the mantel, and the combination; some of these were made as early as 1847. The demand for folding-beds, which reached its climax a few years ago, is now showing a material decline.

The woods used in the manufacture of furniture are varied, and subject to frequent changes. Early in the century, mahogany, maple, and black walnut were in favor; then cherry and ash became fashionable; toward 1880, oak, so long forgotten, took a prominent place. At the present time black walnut is almost entirely out of use. Oak has kept its popularity for the hall, the library, and the dining-room. Mahogany, curly birch, and maple are still extensively used; all of them for the bedroom, and mahogany for the dining-room and the drawing-room in the better grades of furniture. The changes in furniture covering have been more frequent and radical than those in the woods. Haircloth and other coverings in use 30 years ago have been superseded by materials more varied in texture and coloring. Their variety is almost endless, and they show, perhaps as much as anything else, the advance that art as applied to furniture has made in this country. The present centres of the furniture industry are, with one exception (Grand Rapids, Mich.), the largest cities, which, with their densely populated suburbs and surroundings, offer large markets. The cities whose productions amount to more than $2,000,000 per annum, in the order of their importance, are: New York, Chicago, Grand Rapids, Philadelphia, Cincinnati, St. Louis, Boston.

The following statistics show the furniture



CHARACTERISTIC SHERATON FURNITURE

Thomas Sheraton (1751-1806) was the last of the famous cabinet-makers of the 18th century. In 1790 he published his first collection of "Designs for Furniture," and this was followed by numerous other publications of a similar class.

factory product of the United States for 1900 according to the twelfth census:

Alabama	107,185
Arkansas	232,872
California	1,267,986
Colorado	170,055
Connecticut	488,738
Georgia	1,273,462
Illinois	15,285,475
Indiana	8,769,509
Iowa	1,419,862
Kansas	302,339
Kentucky	1,504,083
Louisiana	319,723
Maine	580,737
Maryland	2,976,494
Massachusetts	11,244,503
Michigan	14,614,506
Minnesota	1,932,188
Missouri	3,758,568
Nebraska	211,750
New Hampshire	734,428
New Jersey	808,185
New York	23,643,245
North Carolina	1,547,305
Ohio	9,514,764
Oregon	298,790
Pennsylvania	9,804,677
Rhode Island	32,325
Tennessee	1,106,623
Texas	185,285
Utah	42,732
Vermont	1,252,743
Virginia	212,972
Washington	412,613
West Virginia	454,097
Wisconsin	8,721,823
All other states	83,344
Total	$125,315,986

The furniture industry of the United States has to-day reached a magnitude unknown elsewhere. The perfect equipment and organization of our mammoth factories capable of an enormous production emphasize the necessity for a larger market. Intelligent efforts are now being made in this direction by a number of manufacturers with the hope that eventually a large foreign trade may be secured for our American product. GEORGE W. GAY,

Revised by GEORGE G. WHITWORTH, *Berkey & Gay Furniture Co., Grand Rapids, Mich.*

Fur'nivall, Frederick James, English scholar: b. Egham, Surrey, 4 Feb. 1825. He was educated at University College, London, and Trinity Hall, Cambridge, where he graduated B.A. in 1846, and M.A. in 1849, and adopted the study of the law, being called to the bar in 1849. He has, however, devoted his life chiefly to the study of early and middle English literature; and he has been mainly instrumental in establishing the Early English Text Society, the Chaucer Society, the New Shakespeare Society, the Browning Society, the Wickliffe Society, and the Shelley Society. He is also honorary secretary of the Philological Society. The societies named have given a powerful impulse to English scholarship by their publications, and this is in no small measure due to Dr. Furnivall. For them and for the Roxburghe Club and the Rolls Series he has edited numerous works, notably the Six-Text edition of Chaucer's 'Canterbury Tales' (1868–75.) Other works of his are: 'Early English Poems and Lives of the Saints' (1862); 'Early English Meals and Manners' (1867); 'Book of Nurture' (1867); 'Education in Early England' (1867); 'Bibliography of Browning' (1881); and 'The Fifty Earliest English Wills in Court of Probate' (1882).

Furrer, fur'ĕr, **Jonas,** Swiss statesman: b Winterthur 1805; d. 1861. After studying at Zurich, Heidelberg, and Göttingen, he became president of the Grand Council of Switzerland in 1839, a position which he again occupied in 1844. In 1845 he received his appointment as president of the Cantonal Diet, and when the new Federal Constitution went into effect he was elected president of the Swiss Confederation. He wrote 'Das Erbrecht der Stadt Winterthur' (1832).

Fursch-Madi, Emma, French opera singer: b. Bayonne, France, 1847; d. Warrenville, N. J., 19 Sept. 1894. After studying at the Paris conservatory, she began to sing in public concerts under the direction of Pasdeloup, and then appeared in opera, first as Marguerite in 'Faust,' and then in Verdi's opera 'Aïda' at the Théâtre de la Monnaie, in Brussels. For three years she sang in Covent Garden, London, and in 1884 came to New York to fill an engagement at the Academy of Music. She then appeared frequently at the Metropolitan Opera House. From 1891 she taught music and singing in the New York College of Music.

Fürst, Julius, German scholar: b. Zerkowo, Posen (Prussian Poland), 12 May 1805; d. Leipsic 9 Feb. 1873. He was of Jewish parentage, and at an early age he had a remarkable knowledge of Hebrew literature, Old Testament Scriptures and Oriental languages. In 1825, after having studied at Berlin, he took a course in Jewish theology at Posen. In 1829, after having abandoned his Jewish orthodoxy, he went to Breslau, and in 1831 to Halle, where he completed his studies in Oriental languages and theology. In 1833 he entered journalism in Leipsic, later securing a position as tutor and lecturer in the university there, from which position he was promoted in 1864 to the chair of Oriental languages and literature, a post he filled with great distinction until his death. His works, especially those on the Semitic languages, are of great value, and among the most important may be mentioned: 'Lehrgebäude der aramäischen Idiome' (1835); 'Concordantiæ librorum Sacrorum veteris Testamenti Hebraicæ et Chaldaicæ' (1837–40); 'Bibliotheca Judaica' (1849–63); 'Hebräisches und Chaldäisches Handwörterbuch' (1851–61); 'Geschichte des Karäerthums' (1862–5); 'Geschichte der biblischen Litteratur und des jüdisch-hellenistischen Schrifttums' (1867–70). From 1840–51 he edited 'Der Orient.'

Furst, William, American composer and conductor: b. Baltimore, Md., 25 March 1852. He studied music in his native town and at the age of 14 was a church organist. His comic opera 'Electric Light' was produced and conducted by him in 1878 and for the five seasons following he received engagements as conductor of opera. He became musical director of the Tivoli Theatre, San Francisco, in 1884. His opera 'She' ran for nine weeks there, and was produced for two seasons in New York. His chief productions are: 'Theodora' (1888); 'The Isle of Champagne' (1891); 'Honeymooners' (1893); 'Princess Nicotine' (1893); 'The Little Trooper' (1894); 'Ghismonda' (1894); 'The Merry World' (1895).

Furtado, Francisco José, Brazilian statesman: b. Oeiras (Piauhy) 13 Aug. 1818; d. Rio de Janeiro 23 June 1870. After graduating from the Academy of Law at Caxias and serving for some time as judge, he entered politics and rose to be leader of the Liberals. In 1847 he was elected deputy and re-elected several times. In 1856 he was elected president of the new province of Amazonas, remaining such until 1859, when he was made minister of justice. In 1864 he was elected senator, but held that position for a few months only, and in August 1864 was made premier and minister of state, in which position he did much toward the establishment of a good monetary system. During his term of office as minister of state the dispute with Uruguay was settled and war between Brazil and Paraguay was declared. In 1870 he was again a member of the Senate and as such, being an opponent of slavery, exerted all his influence in behalf of legislation looking toward its final abolition.

Fury and Hecla Strait, in the Arctic region, in lat. 70° N., separates Melville Peninsula from Cockburn Island, and connects Fox Channel with the Gulf of Boothia. It was discovered by Parry (q.v.) in 1822, and named after his ships.

Furze, fėrz, a European genus (*Ulex*) of very branched and thorny shrubs, with linear sharply pointed leaves, solitary flowers, and two-lipped calyx, belonging to the order *Leguminosæ*, sub-order *Papilionaceæ*. The common furze (*U. europæus*), also called whin and gorse, is abundant in many parts of southern Europe and in Great Britain, although not reaching any considerable elevation, and often suffering from the frost of severe winters. It affords a wholesome fodder, especially when young, or when the thorns are artificially bruised, and is grown often on dry and barren hillsides not fitted for other forage crops. A double flowering variety is grown in gardens.

Fusan, foo-sän', or **Pusan**, Korea, a seaport town on the south shore of the peninsula, from the 16th century became more and more under Japanese influence. In 1876 it was formally opened to Japanese trade, and soon after to all nations. At the outbreak of the war between Japan and China (1894–5) the bulk of the population were Japanese, who have the trade in their hands. The imports (chiefly Manchester goods, salt, and Japanese wares) have an annual value of over $1,000,000; the exports (rice, beans, hides, etc.), of $1,300,000. Pop. (1900) 15,000, of which 10,000 are foreigners.

Fuse, a device employed for firing explosives. In mining, quarrying and in military and naval mining operations there is used the "Bickford, safety running" or "tape" fuse which consists of a tubular cord of cotton or hemp that has been rendered slowly combustible, the cavity in the centre of the cord being filled with a slow-burning gunpowder composition. To make the fuse firm and hard, so as to prevent its being cut by the sharp edges of the rock during tamping, the outside of the cord is served with a covering of strong twine, which is wound about it at nearly right angles to the direction of the twist of the cord by the process called countering. To protect the powder from moisture, the wrapped fuse is immersed in a bath of heated varnish composed of glue, soap, and whiting. Finally, to prevent the surfaces of the fuse from sticking together when coiled they are coated with dry whiting, bran, or powdered soapstone. The fuse described is known as "single fuse" and, as the varnish used is not waterproof, this fuse is only suitable for use in dry ground. In wet ground, a fuse is used which is made by coating the countered cord with tar or resin varnish and then, before the varnish is quite set, countering it with tape and again coating it with varnish. This is known as "taped fuse." When the fuse is to be subjected to especially severe treatment, it is provided with a double coat of twine or thread and is known as "double fuse." The varieties in use are: "common hemp fuse"; "common cotton fuse"; "white fuse"; "superior mining fuse"; "single-taped fuse"; "double-taped fuse"; "triple-taped fuse"; "small gutta-percha"; "large gutta-percha"; "small gutta-percha taped," and "large gutta-percha taped." Running fuse comes in lengths of about 50 feet, and, when properly made, is so uniform in quality that it can be depended upon to burn at the rate of 3 feet per minute. This is important, as it is necessary for the safety of the operator. The fuse should be stored in a dry place so that the powder core may not become damp; and, if so treated, it will retain its efficiency until the varnish has lost all its essential oils and become dusty. Care must be taken not to touch the tape with any oily or greasy matter, as this penetrates through the varnish to the powder core and affects the rate of burning. The fuse should not be roughly handled, as pinching and squeezing alter the rate at which the powder burns. Care should be exercised in opening out a coil which has become stiff through age or exposure to cold weather, for the fuse is then brittle, and if the covering is cracked by sudden and violent unrolling the fuse becomes unfit for use. If there be any doubt as to the behavior of a coil of fuse a piece one foot long should be taken and its rate of burning timed.

Although in firing single charges, safety fuse answers admirably, where several charges are to be fired simultaneously, the safety fuses are connected together by "instantaneous fuses." These consist of a strand of quickmatch enclosed in hemp or flax and several layers of gutta-percha and tape, or of a core of guncotton enclosed in a leaden tube. Besides these nitroglycerin compositions have been proposed by Quentin and Nobel, and one containing mercuric fulminate by Philip Hess.

In naval and military operations, and for simultaneous blasts in mining and quarrying, "electric fuses" are preferred to running fuses. These are gunpowder "igniters" or fulminate "detonators," that are fired by electricity. They are classified as "low tension fuses," designed for use with strong currents of low potential, from primary or secondary batteries, or from dynamo-electric machines; "medium tension fuses," for use with magneto-electric machines which generate currents of medium potential, and "high tension fuses," for use with condensed sparks capable of traversing a sensible air space. The use of the word tension is not warranted by the present condition of electrical science, but it has become technical in this art. To-day, only low tension electric fuses are employed and they are described under Detonators (q.v.).

Fuses are employed in ordnance for exploding shell and they may consist of a compressed core of gunpowder enclosed in a tube of wood or metal, or of a fulminating composition or of both. They are known as "nose fuses" when put in the front end or "nose" of the conical pointed shell, or "base fuses" when inserted in the lower end or base of the shell. They are known as "time fuses," when they are planned to burn a certain length of time after they have become ignited, before they set fire to the explosive charge in the shell; "percussion fuses" when they are set in operation by the impact of the shell against an object after it has been projected from the gun. They may act instantaneously in firing the charge in the shell, or there may be a column of compressed powder interposed between the charge of explosive in the shell and the fulminating composition which is fired by impact. As sometimes a second or more intervenes between the striking and the bursting of the shell, these are styled "delayed action fuses." They may be used with armor piercing shells designed to penetrate armor and burst within the ship. In time fuses, used with spherical shell, the powder in the fuse used to be ignited from the flame of the burning charge with which the shell was propelled from the gun. In modern time fuses, there is a metal cylinder which serves as a hammer placed within the fuse case and held in place by brittle pegs of metal, or by a number of small balls. When the shell containing such fuses is fired, the inertia causes the hammer to strip from the pegs and set back toward the base of the shell, or, if it be a shell from a rifled gun, the centrifugal force causes the balls to fly outward and release the hammer. When the shell strikes, and is arrested in its flight, the hammer moves forward, strikes a percussion cap and fires the charge.

"Chemical fuses" have been used in firing gunpowder mines and torpedoes. As an example of these we cite the mixture of cane sugar and potassium chlorate used in the Harvey torpedo. Above a column of this mixture was placed a small glass bulb filled with concentrated sulphuric acid, the whole being enclosed by a soft copper cover projecting from the torpedo. When this cap was struck, it collapsed and broke the glass bulb, and, as the sulphuric acid came in contact with the mixture of sugar and chlorate, the latter burst into flame and ignited the powder in the torpedo. Such fuses have been used by anarchists in infernal machines and they have ascertained the rate at which the acid would eat through sheets of bibulous paper so that by interposing a sufficient number of sheets of paper they could set the train in operation and get safely out of the way before the machine exploded. Fuses, consisting of columns of compressed gunpowder composition, are used in pyrotechny by which to ignite the charges in rockets, bombs, roman candles and other devices. By their use the operator is enabled to get to a safe distance after igniting the device before it functions fully.

Fuses are used in "electrical installations," but these are of an entirely different character from the above. They consist of strips of metal of low fusibility which are interposed, in electric lighting and other circuits, between the generator and the lamp, or other device, to prevent damage to the device by an excess of current. When the load is greater than is desired the current heats the fuse to its fusion point, when it melts and cuts out the circuit. See ELECTRIC FUSES; EXPLOSIVES.

CHAS. E. MUNROE,
Columbian University, Washington, D. C.

Fusee, fū-zē', in clock and watch making, is the conical pulley used in connection with the main spring, to equalize the power of the latter, so that the watch may run regularly. The spring coiled within the barrel, when fully wound up and at its greatest tension, draws on the part of the chain wound on the smaller portion of the fusee. The first wheel of the watch or clock is attached to the fusee, and as the latter unwinds by the gearing motion in the watch, the spring also uncoils and loses a part of its tension; as this proceeds, the chain draws on a larger portion of the fusee, and attains an increased leverage on the latter to counterbalance the decreased power of the spring.

Fusel Oil, an injurious and exceedingly objectionable constituent of improperly prepared distilled liquors (q.v.), consisting of an indefinite and variable mixture of amyl alcohol (see AMYL) with certain other alcohols and ethers, and certain organic acids and their esters. Fusel oil always contains amyl alcohol, and usually contains butyl and propyl alcohols also. It comes over in the later parts of the distillate, and may be separated from ethyl alcohol (in large measure at least) by resort to fractional distillation.

Fushimi, foo-shē'mē, Japan, a seaport town in the province of Yamashiro, southern coast of Nippon, on the right bank of the river Uji-gawa, which serves as a trade outlet and depot for Kioto, Otsu, and Nara, and is connected by steam service with Osaka. Pop. (1900) 21,515.

Fusible Metal, any alloy, or metallic mixture, which melts at a comparatively low temperature. (See ALLOY; AMALGAM; BISMUTH; CADMIUM.) Fusible metals are used in the arts for many purposes. Automatic sprinklers, for example, are capped with alloys of this sort, which are chosen so as to have melting points that are higher than any temperature that would normally occur in the room that is to be protected. If a fire breaks out, however, the abnormal rise of temperature so produced causes them to melt, the water in the sprinkler pipes being thereby released, and the fire extinguished. Fusible metals have also been used quite generally in the manufacture of "fusible plugs," for the protection of steam boilers; such plugs being screwed into the boiler at the height which is considered to be the lowest limit to which the water level in the boiler can be allowed to descend with safety. So long as the inner end of the plug is covered with water, the plug itself is thereby kept too cool to melt under the influence of the furnace gases; but when the protecting action of the water is removed by the water level descending below the safety limit, the hot furnace gases melt the material of the plug, and the steam in the boiler escapes. Fusible plugs are excellent appliances, and in fact they are required by law in some of the States. There is no advantage in filling them with an alloy, however, because in any event the alloy must have a melting point higher than

that of the steam that the boiler is to generate (365° F., for a gauge pressure of 150 pounds per square inch), and pure tin, with a melting point of 450° F., is entirely satisfactory for the purpose. Indeed, tin is far superior to any alloy for this purpose, because its melting point remains sensibly constant for an indefinite time (so long as oxidation is prevented), while the melting points of alloys that are continuously exposed to heat for considerable periods become quite uncertain, and are often found to be far higher than when the alloy is freshly prepared.

Fusible Plug. See FUSIBLE METAL.

Fusidæ, fū'sī-dē, a family of gastropod mollusks, by some conchologists regarded as only a genus (*Fusus*) of the family *Fasciolariidæ.* In either case it is a world-marked group allied to the turban-shells and volutes in structure, but having a long, more or less spindle-shaped, comparatively thin shell, with a very long canal. The animal is closely similar in its soft parts to a whelk or a murex. The family contains the genera *Fasciolaria, Clavella, Latirus,* etc., but interest centres chiefly on the genus *Fusus,* of which many species are known in various parts of the world, and which goes back to Cretaceous time in geological history. North American species are inconspicuous, but some of the several kinds found upon the coast of Great Britain are highly valued by collectors of shells, and constantly sought for by fishermen who bring them up in their dredges from time to time. The "red-whelk" or "roaring buckie" of Scotland is a species (*F. antiquus*) made famous in folklore and by Wordsworth's poem; and it is extensively eaten in various parts of Great Britain and along the continental coast. In Zetland its shell was formerly used by the peasantry as an oil lamp. *F. proboscidialis* is one of the largest of mollusks.

Fusing Point. See MELTING POINT.

Fustel de Coulanges. See COULANGES, NUMA DENIS FUSTEL DE.

Fus'tian, named after Fustat, a suburb of Cairo, where the material originated, is (1) a species of cotton cloth similar to velvet, having, in addition to the warp and weft, a species of pile, consisting of other threads doubled together, which are thrown up in ridges and conceal the groundwork of the fabric. When in the loom, this pile presents the appearance of a set of loops; these are cut in two and sheared down, and when polished and finished, present an evenly ribbed surface on the exterior. The best fustians are known as cotton-velvet and velveteen; besides these there are moleskin, corduroy, and several other kinds. (See WEAVING.) (2) In literature, fustian signifies a forced, bombastic style of writing, abounding with metaphors or other rhetorical figures.

Futa-Jallon, foo'tä zhä-lôn', a region of West Africa, in Senegambia. It is extremely mountainous, and remarkable for the romantic beauty of its scenery; and is the source of the rivers Senegal, Gambia, etc. Large herds and flocks are pastured; and the soil produces in abundance bananas and other fruits, besides numerous palm-trees, which furnish dates, wine, and oil. The inhabitants are fanatical Mohammedans. They are governed by an elective chief under French protection. The capital is Timbo. Pop. (1900) 600,000.

Futhark, foo'thôrk, the Runic alphabet which derives its name from the first six letters, *f, u, th, a, r, k,* and is applied to all the systems of phonetic signs of the Teutonic stock, for the same reason as those of classical derivation are called "alphabet" or "abecedarium." They occur in the same order in Old German, Gothic, Anglo-Saxon, and Northern Runes, with a nomenclature in all of them borrowed from trees and other familiar natural objects, suggestive of the derivation of the series of phonetic symbols from a primitive system of pictorial writing. See ALPHABET; RUNIC CHARACTERS.

Fyffe, fīf, **Charles Alan,** English historian: b. Blackheath, Kent, England, December 1845; d. 19 Feb. 1892. He was graduated at Oxford in 1868; and called to the bar in 1876, but never practised. As correspondent of the *Daily News* during the Franco-Prussian war he is said to have sent to that journal the first account of the battle of Sedan that appeared in print. His historical works are distinguished by accuracy and a pleasing, perspicuous style. They include: 'History of Greece' (1875), in a series of 'History Primers'; and the well-known 'History of Modern Europe' (1880, 1886, 1890), covering the period from 1792 to 1878.

Fyles, Franklin, American dramatic critic and author. In 1886 he became dramatic critic of the New York *Sun.* He wrote several successful plays, including the military dramas, 'Cumberland '61,' and 'The Girl I Left Behind Me,' and some works in book form, among them 'The Theatre and Its People,' a popular account of the profession; 'A Ward of France'; 'Drusa Wayne'; etc.

G

G seventh letter of the English alphabet and of other alphabets derived from the Latin. In very early Latin, G stood for the proper g-sound (g hard, as in go) and also for the k-sound of C, as in cup; afterward the k-sound was represented by K, while G continued to represent the sound of G hard; but K did not remain long in the Latin alphabet, being superseded by C (always hard and equivalent to K). Both in Greek and Latin the gamma (Γ, G) was always the hard guttural in whatever situation, and hence *geographia* was pronounced gheographia, *genus* ghenus, etc. The softening of g-hard to j when g precedes e, i, or y, began to prevail in the 6th century of our era, and it persists in the modern languages derived from Latin and in our own. In languages having words derived independently by each from some common stock, for example, the Indo-European languages, the interchange of c-hard, g-hard, k, and the aspirate gutturals ch, gh, is very common; examples: Eng. kin, Lat. *genus,* Gr. *genos;* Gr. *chen,* Ger. *gans,* Eng. goose; Gr. *gnonai,* archaic Lat. *gnosco,* Ger. *kennen,* Eng. ken; Lat. *hesternus,* Gr. *chthes,* Ger. *gestern,* Eng. yester: the same equivalence of g and y is seen in Ger. *gelb,* Eng. yellow; Ger. *gähnen,* Eng. yawn; Ger. *garn,* Eng. yarn. In French words of Teutonic origin an original w is often represented by gu (equal to g-hard), thus Wilhelm becomes *Guillaume;* Ger. *weise,* Fr. *guise;* Teuton *werra,* Eng. war, Fr. *guerre.*

Gabb, William More, American palæontologist: b. Philadelphia 1839; d. 1878. In 1862–5 he was director of the palæontological section of J. D. Whitney's geological survey of California, and later made surveys in Santo Domingo (1868) and Costa Rica (1873). His publications include: Vols. I. and II. of the 'Geological Survey of California' (1864); and monographs on the topography and ethnology of Costa Rica and the geology and topography of Santo Domingo in the 'Transactions' of the American Philosophical Society and Petermann's 'Mittheilungen.'

Gabbro, găb'rō, a general name for a large group of evenly crystalline igneous rocks, composed, typically, of plagioclase and pyroxene. Gabbros show by analysis much the same composition as basalts; the silica ranging from 46 to 59 per cent. They may be regarded as plutonic basalts, basalt magmas which have cooled at great depths. Under the general term gabbro, are included anorthosites, abundant in Canada and the Adirondacks, high in silica and composed almost wholly of crystalline labradorite; true gabbros; norites, composed of plagioclase and orthorhombic pyroxene. With decreasing pyroxene and increasing olivine gabbros grade into peridotiles. Gabbros are heavy, dark-colored, usually greenish, rocks. They occur in the Adirondacks, in the neighborhood of Baltimore, Md., and particularly in the highlands along the north shore of Lake Superior, from Duluth to the international boundary. The gabbro near Duluth has this composition: SiO_2 49.15; Al_2O_3 21.90; Fi_2O_3 6.60; FeO 4.54; CaO 8.22; MgO 3.03; Na_2O 3.83; K_2O 1.61. See BASALT.

Gable, the triangular or quadrangular end of a house or other building, from the cornice or eaves to the top, and distinguished from a pediment by this, among other things, that it has no cornices, while a pediment has three. The word is also applied to the highly decorated canopy or screen which in Gothic church architecture rises over some doors or windows. The wall of a house which is surmounted by a gable is called the gable-end. In modern towns the gable-ends of houses are usually at right angles to the line of the street, but in the Middle Ages the reverse was usually the case, the gable-ends being turned toward the street. Many old towns in France, Belgium, and Germany, are still to be seen with this peculiarity, and some even in Britain. In Scotland, a wall separating two houses, and common to both, is called a mutual gable, and according to Scotch law such a gable is the property of the builder, who can therefore prevent the owner of an adjoining property from using the support of his gable, unless he pays half the cost of erecting it.

Gaboriau, Emile, ā-mēl gä-bō-rē-ō, French writer of detective stories: b. Saujon, Charente-Inférieure, France, 9 Nov. 1835; d. Paris 28 Sept. 1873. His early years were a succession of vicissitudes; the army, the law, and even the Church, were in turn the objects of his inconstant attentions till at last when he had already contributed to some of the smaller Parisian papers, he leaped into fame at a single bound with his story 'L'Affaire Lerouge' (1866), in the feuilleton to 'Le Pays.' It was quickly followed by 'Le Dossier 113' (1867); 'Le Crime d'Orcival' (1868); 'Monsieur Lecoq' (1869); 'Les Esclaves de Paris' (1869); 'La Vie Infernale' (1870); 'La Clique Dorée' (1871); 'La Corde au Cou' (1873); 'L'Argent des Autres' (1874); and 'La Dégringolade' (1876).

Gabriac, Paul Joseph de Cadoine, pōl zhō-zĕf dė kä-dwän gä-brē-äk, MARQUIS DE, French diplomatist: b. Heidelberg, Baden, 1 March 1792; d. Paris 12 June 1865. He was

consul-general in New York in 1812–14; appointed minister to Stockholm in 1823; and minister to Brazil in 1826. While in Brazil he induced all the other states in South America to adopt the French maritime law. He was created a peer in 1841, and made a life senator in 1853. His publications include: 'The Question of Brazil' (1829); 'The Republics of South America Considered in Their Future' (1851); 'King Pedro I., Notes and Personal Recollections' (1854).

Ga'briel (Heb. "hero of God"), among the post-exilic Jews, one of the seven archangels (q.v.). In the book of Daniel and in the third gospel he is the messenger and interpreter of God. The rabbins represented him as the angel of death to the Israelites, as Azrael was to the Mohammedans. According to the Talmud he is the prince of fire, who presides over the thunderstorms and the autumnal ripening of fruits. By the command of God he set fire to the temple before it could be burned down by the soldiers of Nebuchadnezzar. According to the teaching of the Koran he is one of the four angels, of which the other three are Michael, Uriel, and Raphael, most highly favored by God, and dictated the Koran to Mohammed.

Gabriel, Brothers of Saint, an order of the Roman Catholic Church in France, founded by the Abbé Deshayes in 1835. Its object was stated as the education of the young, especially deaf-mutes and the blind. In 1880 the order reported 122 elementary schools, 3 boarding schools, 8 schools for deaf-mutes, and 2 for the blind. Its headquarters are at Saint Laurent-sur-Sèvre, La Vendée.

Gabriels, Henry, American Roman Catholic prelate: b. Wannegem-Lede, Belgium, 6 Oct. 1838. He studied classics in the colleges of Audenarde and Saint Nicholas and theology in the Seminary of Ghent, where he was ordained priest, 21 Sept. 1861. He continued his studies at the University of Louvain, from which institution he received the degree of S. T. L. in 1864 and the honorary degree of Doctor in Theology in 1882. When the Theological Seminary of Troy, N. Y., was founded, Dr. Gabriels was one of the four priests sent from Belgium to manage it. He was diocesan examiner for New York and Albany, vicar-general of Ogdensburg and Burlington and one of the secretaries of the Third Plenary Council of Baltimore, the decrees of which he assisted in formulating. For 20 years Dr. Gabriels was rector of Troy Seminary and for nearly 30 years its professor of dogmatic theology, Church history and Hebrew. On 21 Dec. 1891, Pope Leo XIII. appointed him bishop of Ogdensburg and he was consecrated at Albany, N. Y., 5 May 1892. The diocese of Ogdensburg at present (1905) has a Catholic population of about 84,000; 121 priests; 138 churches; 16 parochial schools; 5 hospitals; 2 orphanages, etc. King Leopold of Belgium has recently conferred upon him the decoration of the Royal Order of Leopolds, in recognition of the services he has rendered the Belgium Church and people, particularly by his writings.

Gabriel's Insurrection, an attempted slave rising near Richmond, Va., in 1800, headed by a slave named Gabriel, called also "General Gabriel" and "Jack Bowler." He belonged to a planter named Thomas Prosser, and was about 24; tall, powerful, and noted as a fighter. He drew about a thousand negroes into a plot to attack Richmond by night, massacre the inhabitants, seize the arsenal and arming themselves effectively, rouse a general insurrection. One August night he collected his forces, armed them with scythe blades, and marched toward the city. Meanwhile a negro had disclosed the plot; James Monroe, then governor, had ordered out the militia; a creek in Gabriel's way proved to be unfordable, and hearing that the citizens were in arms, the whole force dispersed to the swamps and woods. They were hunted out, and many hanged, including Gabriel.

Gade, Niels Wilhelm, nēls vĭl'hĕlm gä'dė, Danish composer: b. Copenhagen 22 Feb. 1817; d. there 21 Dec. 1890. In 1841, by his overture entitled, 'Echoes of Ossian,' he gained in Copenhagen the prize of the Musical Union. He was supported during his studies abroad by a royal stipend, and in 1844 was appointed to succeed Mendelssohn in the direction of the Gewandhaus concerts at Leipsic. In 1850 he was appointed musical director to the king of Denmark, and in 1876 received a life pension. His works, which are Mendelssohnian in character, include seven symphonies, several overtures, sonatas, quintets, etc.; a lyrical drama, 'Comala'; a religious cantata, 'The Crusaders'; an opera, 'The Nibelungen'; etc.

Gadfly. See HORSEFLY.

Gadidæ, găd'ĭ-dē, a family of fishes, the cods, sub-order *Anacanthini* (spineless fishes), with ventral fins attached to the breast or throat. The body is rather long, a little compressed, and covered with small, soft scales; the teeth are in several rows; the gill covers, which are large, have seven rays; the median fins are generally very large, and divided into several portions. They are voracious fishes. They are found chiefly in the depths of the colder seas, and are largely used for the food of man. Fossil remains are rare, but scattered bones have been found as far back as the Eocene. See COD; HADDOCK; LING; etc.

Gadolin, gä'dō-lēn, **John,** Finnish chemist: b. Abo, Finland, 5 June 1760; d. Wirmo, Finland, 15 Aug. 1852. He studied chemistry under Bergman and in 1797 was appointed professor of chemistry in Abo — an office which he held till 1822. He devoted himself to investigations on mineral and metallurgic subjects. But the research for which he is specially remembered was upon a black mineral found in the porcelain feldspar quarry at Ytterby, near Stockholm, by Arhenius, of which an account had been published in 1788. In 1794 he read a paper to the Academy of Sciences, and showed that it contained a new kind of earth. This discovery was subsequently confirmed by Ekeberg, who called the earth yttria, and the mineral gadolinite, after its first investigator. The yttria was afterward shown to be a mixture of several earths.

Gads'den, Christopher, American patriot: b. Charleston, S. C., 1724; d. there 28 Aug. 1805. He was educated in England; returned to the United States in 1741 and later engaged in business in Philadelphia; was a member of the first Colonial Congress which convened in New York in October 1765, and was also a member of the first Continental Congress which assem-

bled in Philadelphia in 1774. He joined the American army as colonel at the beginning of the Revolution, and was promoted brigadier-general in 1776.

Gadsden, James, American diplomatist: b. Charleston, S. C., 15 May 1788; d. there 25 Dec. 1858. He was graduated at Yale College in 1806; served with distinction in the War of 1812; and afterward took part in the campaign against the Seminole Indians. He was appointed minister to Mexico in 1853, and on 30 December of that year negotiated the Gadsden Purchase (q.v.), which fixed a new boundary between Mexico and the United States.

Gadsden, Ala., town and county-seat of Etowah County, on the Gadsden and Attalla Union, the Louisville and Nashville, and other railroads, 60 miles northeast of Birmingham. It is dominated by Lookout Mountain, on the north bank of the Coosa River which gives its name to the rich coal and iron mines in the vicinity. There are several steam-mills which manufacture considerable quantities of yellow-pine lumber. Further industries include steel and wire-nail mills, cotton mills, a pipe works, a car and foundry establishment, a pressed-brick plant, a cotton-seed oil mill and ginnery, and coal and iron interests. There are 15 churches, a national and a state bank, and two newspapers, a daily and a semi-weekly. Pop. (1900) 4,282.

Gadsden Purchase, The, a tract of territory, embracing 45,535 square miles, which was purchased by the United States from Mexico in 1854. This region, which is bounded on the north by the Gila River, on the east by the Rio Grande, and on the west by the Colorado, was acquired by treaty and the payment of $10,000,000, and is now included in the southern part of the Territories of Arizona and New Mexico. It is called the Gadsden Purchase after James Gadsden (q.v.), United States minister to Mexico in 1853, by whom, in December of that year, the treaty of sale was negotiated with Santa Anna (q.v.). Issues growing out of the execution of the treaty of Guadalupe-Hidalgo (q.v.) made this negotiation a matter of great importance, as well as a business of much difficulty. Disputes had arisen concerning the boundary line between Chihuahua and New Mexico, involving the possession of the Mesilla Valley, of which, though claimed by the United States, the Mexicans took armed possession. The 11th article of the treaty, imposing upon the United States the obligation to restrain the Indian marauders on the Mexican frontier, had been neglected, and the reclamations in consequence amounted to between $15,000,000 and $30,000,000. By Gadsden's treaty that article was abrogated and a new boundary was agreed upon, while Mexico also agreed to forego all claims against the United States for damages on account of Indian depredations between the years 1848–53. The settlement of the boundary dispute was considered in this country to be of greater moment than the requisition of the land, which was thought to be of little or no value for cultivation; and it was in the minds of enterprising Americans that through this region the Southern Pacific Railroad, already projected, might find an advantageous route, as in fact it did. In Mexico the transaction was vigorously opposed, and on account of his part in the sale Santa Anna, in 1855, was banished from his country as a traitor. On the part of the United States, the Senate made some modifications in the original treaty and then ratified it. On 10 June 1854 it was finally proclaimed. Consult Haswell, 'Treaties and Conventions.'

Gadsden Treaty. See ANNEXATION; GADSDEN PURCHASE.

Gads'hill, England, a hill near Rochester, on the road from London to Gravesend. It is commemorated in Shakespeare's play, 'Henry IV.,' as the place where Falstaff had his encounter with the robbers, and an inn at the place is called Falstaff's Inn. It is interesting in modern times for Gadshill Place, opposite the hill, which was long the residence of Charles Dickens and was the home in which he died.

Gadski, Johanna, yō-hän'nä gädz'kē, German opera singer: b. Anclam, Prussia, 1871. She received her musical training in Stettin, made her début in opera in New York, and appeared as Brünhiide and in numerous other Wagnerian parts. She made a concert-tour in America in 1898–9.

Gad'wall, or **Gray Duck,** a migratory wild duck (*Chaulelasmus streperus*) found on all the four continents. It is less in size than the mallard, and mainly black, brown, and white in color. It frequents western marshes in small flocks, but is rare east of the Alleghany Mountains. As a table delicacy it is highly prized.

Gæa, jē'ä, or **Ge,** jē, in Greek mythology, the goddess of the earth. She appears in Hesiod as the first-born of Chaos, and the mother of Uranus and Pontus. She also bore the Titans, Cyclops, Erinyes, Giants, etc. As the vapors which were supposed to produce divine inspiration rose from the earth, Gæa came to be regarded as an oracular divinity; the oracles at Delphi and Olympia were believed to have once belonged to her. Her worship extended over all Greece, black female lambs being offered on her altars. She was also the goddess of marriage, and again of death and the lower world. At Rome Gæa was worshipped as Tellus.

Gaedertz, gĕd'ērts, **Karl Theodor,** German poet: b. Lübeck 8 Jan. 1855. In 1880 he obtained a post in the Royal Library of Berlin, of which he became chief librarian in 1900. His poems in Low German include 'Tulklapp' (1879) and 'Eine Komödie' (2d ed. 1881).

Gæl, gāl, the name of a branch of the Celts inhabiting the Highlands of Scotland, Ireland, and the Isle of Man. Gadhel, or Gæl, is the only name by which those who speak the Gælic language are known to themselves. By way of distinction the Highlanders of Scotland call themselves Gæl Albinnich (Gæls of Albin) and the Celtic population of Ireland call themselves Gæl Erinnich (Gæls of Erin). See CELTS.

Gælic Language and Literature. See CELTIC LANGUAGE AND LITERATURE.

Gag-rules, a series of rules adopted 1836–44 by the House of Representatives, to prevent the reception of anti-slavery petitions and check the possibility of debate on the subject. No other measure created more virulent debate. The Constitution forbids Congress to pass any law "abridging the right of the peo-

ple to petition the government for a redress of grievances," and impliedly to refuse to receive petitions, as an unheard petition is a nullity. From 1831 on, the abolition societies rained petitions on Congress, urging the abolition of slavery in the District of Columbia, over which it had complete legislative power. They were referred to the commitee on the District, which at first reported adversely, then ceased to report at all, despite complaints. The 24th Congress, 1835–6, laid them on the table instead; but in both Houses there soon arose an outcry to bar them from congressional cognizance altogether. In the Senate, Calhoun on 7 Jan. 1836 moved not to receive two such petitions, on the ground that the South must in the end be worn out and degraded by having constantly to justify its institutions, before a body which had no jurisdiction over them anywhere; but after two months' debate, it was voted to receive them and they were immediately rejected, which remained the rule thereafter. In the House, on 8 February, Henry L. Pinckney of South Carolina moved that all the petitions be referred to a select committee, under instructions to report that Congress could not constitutionally interfere with slavery in the States, and ought not to do so in the District; on 18 May the committee so reported, with another resolution that all petitions relating to slavery be laid on the table without action or reference. Under the previous question both resolutions were passed 25–26 May; the last 117 to 68, John Quincy Adams refusing to vote and denouncing them as a violation of the Constitution, the rules of the House, and the rights of his constituents. Thereafter Mr. Adams, as the champion of the right of petition, became involved for years in an endless struggle against the "gag." On 18 Jan. 1837 this struggle was renewed. The furious scenes in which Mr. Adams was pitted against nearly all the rest of the House are among the most picturesque in American history. On 21 Dec. 1837, John M. Patton of Virginia moved and secured the passage (122 to 74) of a resolution to lay on the table without debate, reference, or action, all papers concerning slavery in any State, "District or Territory" of the United States. Adams again denounced it and refused to vote. On 11 Dec. 1838 the "Atherton Gag" was moved by Charles J. Atherton of New Hampshire, and passed 126 to 73; it was the same in essence as the others. On 21 Jan. 1840 the House adopted as its 21st Rule that no paper praying the abolition of slavery or the slave trade should in future be received by the House or entertained in any manner. But this only passed by 114 to 108; the refusal of the right of petition was incensing the North, and forcing even Democratic representatives to protest. Thereafter at every session, in adopting the rules, Mr. Adams moved to strike out the 21st; the violence of the assaults on him increased, but the majorities against him decreased. At the special session of 1841 his motion was carried on a motion to adopt the rules only for 10 days, but reconsidered and defeated. Finally, on 3 Dec. 1844 a motion to lay his motion on the table was lost by 104 to 81, and the 21st Rule was abolished by 108 to 80. Nothing of the kind was again attempted. Since 12 Dec. 1853 petitions are no longer presented in the House, but handed to the clerk.

Gage, Frances Dana Barker, American reformer: b. Marietta, Ohio, 1808; d. 1884. In Ohio, and later at St. Louis, Mo., she appeared as a lecturer on total abstinence, women's rights, and anti-slavery, and underwent the many unpleasant experiences then the lot of abolitionists. She served as a nurse in the Civil War, and wrote over the signature "Aunt Fanny."

Gage, Lyman Judson, American financier: b. De Ruyter, N. Y., 28 June 1836. He removed to Rome, N. Y., in 1848, and was educated at the Rome Academy. He worked in the Oneida Central Bank 1853–5, when he went to Chicago, becoming a clerk, and later, bookkeeper and cashier of a planing-mill company. In 1868 he became cashier and in 1891 president of the First National Bank of Chicago. He was the first president of the Board of Directors of the World's Columbian Exposition, and several times president of the American Bankers' Association and the Civic Federation of Chicago. On 5 March 1897 he was appointed secretary of the treasury, by President McKinley; in 1901 was reappointed; resigning in March 1902. He received the degree of LL.D. from the New York University 4 June 1903. He was the originator of the movement for civic reform which started in Chicago under his inspiration and became a national influence. He wrote the platform of the Economic Conferences, a unique feature of Chicago's social organization, where Republican and Democrat, rich and poor, conservative and anarchist, meet for debate and exchange facts and theories.

Gage, Matilda Joslyn, American woman suffragist: b. Cicero, N. Y., 24 March 1826; d. 18 March 1898. She was secretary to the State Woman Suffrage Society of New York in 1869–70, was later for nine years its president, and in 1875–6 president of the National Woman Suffrage Association. She was president of the Woman's National Liberal Union in 1893, published and edited (1878–81) the 'National Citizen,' and wrote a 'Woman's Rights Catechism' (1870); 'Woman as an Inventor' (1871); 'Woman in Church and State' (1893).

Gage, Thomas, English general: b. 1721; d. 2 April 1787. In 1755 he accompanied Braddock's ill-fated expedition as lieutenant-colonel, and as brigadier-general became in 1760 military governor of Montreal, and in 1763 commander-in-chief of the British forces in America. His inflexible character led the government to regard him as well fitted to end the disturbances in the American colonies. In 1774 he was nominated governor of Massachusetts, a post of peculiar difficulty, and his enforcement of the rigorous decrees of Parliament brought matters to a climax. On the night of 18 April 1775 he despatched an expedition to seize a quantity of arms which had been stored at Concord; and next day took place the memorable encounter of Lexington, which announced that the Revolution had begun. The battle of Bunker Hill (q.v.) made him unpopular. For a short time he was commander-in-chief in America, a post he soon resigned to return to England.

Gahnite, gä'nīt, "zinc spinel," is essentially a zinc-aluminate, $Zn\ Al_2O_4$. The variety automolite has this formula; in kreittonnite the zinc is in part replaced by ferrous iron and magnesium, and the aluminum by ferric iron. The

variety dysluite is similar except that manganese is present instead of magnesium. Gahnite usually occurs in octahedrons of a black, gray, dark-green, or brown color, with a hardness of 7.5 to 8. Its most important localities are in Sweden, Bavaria, and Sussex County, New Jersey.

Gail Hamilton. See DODGE, MARY ABIGAIL.

Gaillard, gä-yä, **Claude Ferdinand,** French painter and engraver: b. Paris, France, 7 Jan. 1834; d. there 19 Jan. 1887. He was a pupil of Léon Cogniet, and studied painting and engraving at Ecole des Beaux-Arts. In 1856 he gained the Prix de Rome. Among his pictures are: 'The Education of Achilles' (1863); 'St. Sebastian' (1876); 'Christ at the Tomb' (1877), besides several portraits, and some copies of old masters. His principal engraved portraits are: 'Chateaubriand,' 'Monseigneur Bouvier,' 'Count of Chambord,' 'Monseigneur Merode.' 'The Plates of St. Sebastian,' of one of Botticelli's 'Holy Families,' and of the 'Man With the Pink,' of Van Eyck, rank among the masterpieces of modern engraving. Gaillard gained three medals for engraving and one for painting, and was decorated with the cross of the Legion of Honor in 1876.

Gaillardet, gä-yär-dā, **Théodore Frédéric,** French dramatic author: b. Auxerre 7 April 1808; d. Plessis-Bouchard 12 Aug. 1882. He practised law at Tonnerre. He sent a drama to the Porte Saint-Martin, which partly rewritten by Alexander Dumas, the elder, and signed by him, achieved an enormous success as 'La Tour de Nesle,' 28 May 1832. This led to a duel with Dumas, Gaillardet afterward gaining a lawsuit which permitted him to place his name as one of the authors of the piece. He is the author of two other plays, 'Struensee ou le Medecin de la Reine' (1832), and 'Georges ou le Criminel par Amour' (1833). He also wrote from private papers found at Tonnerre, and the archives of foreign affairs, the 'Memoires du Chevalier d'Eon' (1836, new edition 1866). Coming to New York in 1839 he founded the 'Courrier des Etats Unis,' a French newspaper which he edited until 1848 and which is still published. He returned to France later and served on the editorial staff of the 'Presse.'

Gailor, Thomas Frank, American Protestant Episcopal bishop: b. Jackson, Miss., 17 Sept. 1856. He was graduated from Racine College, Wis., in 1876, and from the General Theological Seminary, New York, in 1879. Entering the ministry he was rector of the Church of the Messiah, Pulaski, Tenn., 1879–82; and in 1882 became professor of ecclesiastical history in the University of the South, Sewanee, Tenn. In 1893 he was consecrated bishop-coadjutor of Tennessee, and in 1898, on the death of Bishop Quintard, became bishop of Tennessee. His writings include: 'A Manual of Devotion'; 'The Apostolical Succession'; 'Things New and Old'; 'The Trust of the Episcopate.'

Gaines, Edmund Pendleton, American army officer: b. Culpeper County, Va., 20 March 1777; d. New Orleans 6 June 1849. He was appointed second lieutenant in the Sixth Regiment, United States Infantry, in 1799, in 1805 became collector of customs of the port of Mobile, Ala., and received the rank of captain 1807. Serving through the War of 1812, he became brigadier-general in 1814, commanding at Fort Erie, in August, until wounded. He afterward became brevet major-general; commanded the Southern Military District during the first war against the Seminoles 1817, the Western District 1821, being wounded in the second war with the Seminoles in 1837, and the Department of the Southwest when war was declared with Mexico.

Gaines, Myra Clark, American claimant: b. New Orleans 1805; d. 1885. She was a daughter of Daniel Clark, who emigrated from Ireland to New Orleans and inherited his uncle's property there in 1799. He was supposed to have lived a bachelor, but it was known that he was the father of two daughters by a French woman of great beauty. He died in 1813; his will gave his property to his mother. In 1830 letters were found detailing the circumstances of Myra's birth; in 1832 one that gave an account of a will made by her father in 1813, in which he acknowledged her as his legitimate daughter and bequeathed her all his property. She then began her remarkable litigation, first to establish her legitimacy, then to secure her father's estate. The supreme court of Louisiana pronounced her legitimate and his lawful heir in 1856. Subsequently, the United States Supreme Court decided that the facts of her father's secret marriage in Philadelphia and her own legitimacy were fully established. Then began the struggle to secure possession of the estate. She filed a bill in equity in the United States Supreme Court in 1856, and a favorable decision was rendered in 1867. In 1861 the property in New Orleans was valued at $35,000,000, and previous to 1874 she obtained $6,000,000. Appeals and counter-suits were in progress at the time of her death in 1885. She married W. W. Whitney in 1832, and at his death Gen. Edmund P. Gaines, in 1839.

Gaines' Mill, Battle of. After the battle of Mechanicsville or Beaver Dam Creek, 26 June 1862, McCall's division was withdrawn from the field of its victory, and Gen. Fitz John Porter, with it and the Fifth corps, took up a defensive position near Gaines' Mill, east of Powhite Creek, a small stream flowing into the Chickahominy. Porter's corps and McCall's division, numbering in all about 20,000 infantry and artillery and 2,500 cavalry, were the only Union troops north of the Chickahominy, the rest of McClellan's army being south of it. Porter's line was formed in the shape of a semicircle, its left resting in the low ground near the Chickahominy, with its right bending around south of Old Cold Harbor. The line was naturally strong, and was strengthened by rifle-pits, by felling trees in front of them, and by piling rails and such other material as was at hand. The east bank of the creek was quite high and the slope to the creek was covered with brush and timber. The line covered several of the bridges over the Chickahominy, and through the centre and right ran the roads from New Cold Harbor and Old Cold Harbor to Dispatch Station. Sykes' division of the Fifth corps was on the right, and Morell's division on the left, with McCall's division in reserve. Gen. Cooke, with three small cavalry regiments, watched the left. The line was somewhat too extended for the number of troops Porter had at his disposal, but these were well posted and his artillery

placed in good positions, sweeping the ground in front. On 27 June the Confederates advanced upon Porter's position, A. P. Hill and Longstreet from the west, Jackson and D. H. Hill from the northwest. A. P. Hill led the advance from Mechanicsville, and on reaching Powhite Creek, near Gaines' Mill, at noon, Gregg's South Carolina brigade was so stoutly resisted by the 9th Massachusetts, holding an advanced position, that Hill was checked and compelled to deploy a large force to push the Massachusetts men back, which consumed the time until 2 P.M. Meanwhile the other divisions had come up, Longstreet on A. P. Hill's right, Jackson, Ewell, and D. H. Hill in the order named, on A. P. Hill's left. The main battle began a little after 2 o'clock with an impetuous assault by A. P. Hill on Porter's left division, and resulted in the final repulse of Hill with great loss. Longstreet came to his support, Jackson and D. H. Hill closed in on Porter's right, and for nearly two hours Porter's entire line was successively assailed and pressed at every point, but held firm, so firm that Gen. Lee thought that "the principal part of the Federal army was on the north side of the Chickahominy" and "apparently gaining ground." McCall's division was placed in line; all fought well and were admirably handled; but there were not enough of Porter's men long to withstand the energetic and continued pressure of 57,000 Confederates at all parts of the line. At about 4 P.M. Slocum's division of Franklin's corps came on the field from beyond the Chickahominy; its three brigades were separated and disposed of in weak places on the line, and the general attack was repulsed about 5 P.M. A few minutes later another attempt was repulsed, the Union line holding fast and not yielding a foot. The Confederate forces were now all up; Whiting's division had come to the relief of A. P. Hill; and Stuart, with his cavalry and artillery, opened heavily on Porter's right. Gen. Lee now ordered a general advance, which was responded to in a most gallant manner. Porter's lines were fiercely assaulted; parts remained firm, but other parts gave way, and soon all gave back, losing 22 guns and some 2,800 prisoners. Some of the commands fell back in much confusion; others retired in good order, upon the brigades of French and Meagher, of Sumner's corps, which had crossed the Chickahominy, and now assisted in checking the Confederate pursuit. During the night the Union troops crossed to the south side of the Chickahominy, destroyed the bridges behind them and joined the rest of the army in its retreat to Harrison's Landing on James River. The entire number of Union troops engaged was about 34,000; the loss was 894 killed, 3,107 wounded, and 2,836 missing, an aggregate of 6,837. The number of Confederate troops engaged was about 57,000, of whom 8,751 were killed and wounded. Consult: 'Official Records,' Vol. XI.; Webb, 'The Pininsula'; 'McClellan's Own Story'; the Century Company's 'Battles and Leaders of the Civil War,' Vol. II.

E. A. Carman.

Gainesville, Fla., city and county-seat of Alachua County, on the Gainesville and Gulf, the Florida Central and Peninsular, and other railroads, 60 miles southwest of Jacksonville. Owing to its temperate climate it is a favorite invalid winter resort. Its industrial interests are chiefly agricultural; fruit growing, especially oranges, is largely carried on. Pop. (1900) 3,633.

Gainesville, Ga., city and county-seat of Hall County, on the Gainesville, and the Richmond & Danville R.R.'s, 53 miles northeast of Atlanta. From its situation at the summit of the Chattahoochee ridge, and owing to the numerous mineral springs in the vicinity, it is a much-frequented health resort. The educational establishments include Gainesville College and the Georgia Seminary. There are milling industries and manufactures of machinery and cars, and the city owns its electric lighting plant and waterworks. Pop. (1900) 4,382.

Gainesville, Texas, city and county-seat of Cooke County, on the Missouri, K. & T., and the Gulf, C. & S. F. R.R.'s., 65 miles north of Fort Worth. This is the centre of an important agricultural and stock-raising district. It has large meat-packing establishments and manufactures of flour, foodstuffs, cotton-seed oil, carriage works, hide and leather factories, and pressed-brick works. The town was first settled in 1851, and was incorporated in 1873. It was governed under a new charter in 1879 with a mayor and council elected by popular vote every two years. Pop. (1900) 7,874.

Gainsborough, gānz'bŭr-ō, **Thomas,** English painter: b. Sudbury, Suffolk, May 1727; d. London 2 Aug. 1788. He was the son of a wool manufacturer, and was educated under his uncle in the grammar-school of his native town. His artistic genius early displayed itself, and for a time he studied art in London under the French engraver Gravelot, and afterward under Frank Hayman. He married at 19, and in 1760 took up his residence in Bath, where he soon acquired a leading position as a portrait painter. He sent pictures to the exhibitions of the Society of Artists from 1761 to 1768, and in the latter year was elected one of the original members of the Royal Academy. He contributed to the Academy exhibitions during the period 1769–72, and again, after an interval of estrangement from Sir Joshua Reynolds, from 1777 till 1783. The pictures shown during the first of these periods comprised some landscapes and numerous portraits, among them those of Garrick (two), the Duke of Argyll, and Lord Nugent. Owing to a quarrel with his friend and patron, Philip Thicknesse, he left Bath for London in 1774, and in the metropolis his fame rapidly increased. Among the pictures exhibited at the Academy after his arrival in London none is more celebrated than the 'Blue Boy' (1779), said to have been painted to refute a statement made by Sir Joshua Reynolds in one of his discourses. Among portraits painted during this period are those of the Duchess of Devonshire, Duchess of Cumberland, Duke of Argyll, Gen. Conway, Sir Bate Dudley, George III. and his queen, Bishop Hurd, the Prince of Wales, Col. St. Leger, Lord Cornwallis, the Princess Royal, and other members of the royal family. Owing to a quarrel about the hanging of some pictures he never exhibited at the Academy after 1783. Before his death he was reconciled to Sir Joshua Reynolds. Among his other works the following should be mentioned: portraits of Mrs. Siddons, Hon. Mrs. Graham, Pitt, Blackstone, Johnson, Sterne, Richardson, Clive,

Burke, Canning, Franklin, besides others; 'The Market Cart'; 'The Watering Place'; 'The Brook'; 'Rustic Children'; 'The Cottage Door'; 'Cows in a Meadow'; 'Gainsborough's Forest'; and other fine landscapes. Both in portrait painting and in landscape painting he is one of the greatest of English masters. A portrait by him of the Duchess of Devonshire was sold in 1876 for £10,605, and was immediately thereafter stolen, not being recovered until 1901 (in the United States). Consult: 'Lives,' by Fulcher (1856); Brock-Arnold (1881); Bell (1897); Wedmore, 'Studies in English Art,' first series (1878); Armstrong, 'Gainsborough and His Place in English Art' (1898); Chamberlain, 'Gainsborough' (1903).

Gairdner, gārd'nėr, **James,** English historian: b. Edinburgh 22 March 1828. At 18 as a clerk he entered the 'Public Record' office in London, where he became assistant keeper in 1859. He has distinguished himself by the rare combination of profound erudition, patient accuracy, and judicial temper which he has shown in the editing of a long series of historical documents: 'Memorials of Henry VII.' (1858); 'Letters and Papers Illustrative of the Reigns of Richard III. and Henry VII.' (1861–3), in the Rolls series; the continuation from Vol. V. onward of the late Prof. Brewer's 'Calendar of Letters and Papers, Foreign and Domestic, of the Reign of Henry VIII.' (9 vols. 1862–86); and 'Historical Collections of a London Citizen' (1876), and 'Three Fifteenth-Century Chronicles' (1880), for the Camden Society series. Equally valuable are the books addressed to a wider audience: an edition of the 'Paston Letters' in Arber's series (1872–5); 'The Houses of Lancaster and York,' in 'Epochs of Modern History' (1874); 'Life and Reign of Richard III.' (1878); 'England' in 'Early Chroniclers of Europe' (1879); 'Studies in English History' (1881), a series of essays written in conjunction with Spedding; and 'Henry VII.,' 'Statesmen' series (1889).

Gairdner, Sir **William Tennant,** Scottish pathologist: b. Edinburgh 8 Nov. 1824. He was graduated M.D. at Edinburgh in 1845, and from 1862 until his retirement in 1900 occupied the chair of practice of medicine in Glasgow University. Among his published books are: 'Pathological Anatomy of Bronchitis and Diseases of the Lungs' (1850); 'Notes on Pericarditis' (1861); 'Clinical Medicine' (1862); 'Public Health in Relation to Air and Water' (1862); 'On Some Modern Aspects of Insanity: Lectures to Practitioners' (1888); 'The Physician as Naturalist' (1889).

Gaisford, Thomas, English scholar and Greek philologist: b. at Ifort, Wiltshire, England, 22 Dec. 1779; d. 2 June 1855. He was educated at Christ Church, Oxford, took orders in the Church, and in 1811 was appointed regius professor of Greek in the University of Oxford. In 1831 he became dean of Christ Church, remaining such till his death, and in 1847 rector of Westwell and curator of the Bodleian Library. He was a prolific writer, his principal works being: 'Hephæstronis Enchiridion de Metres' (Oxford 1810; Leipsic 1832); 'Poetæ Græci Minores' (1814–20, 4 vols.); 'Stobæi Florilegium' (1822, 4 vols.); 'Herodoti Historiæ' (1824); 'Sophoclis Tragædiæ' (Oxford, 1826, 2 vols.; Leipsic 1827, 8 vols.); 'Suidæ Lexicon' (1834, 3 vols.); 'Paræmiographi Græci' (1836); 'Scriptores Latini rei Metricæ' (1837); 'Etymologicum Magnum' (1848); and 'Eusebii Demonstratio Evangelica' (1852, 3 vols.). He was elected a member of the Institute of France, and in 1856 the Gaisford prize, for Greek composition, was founded at Oxford in his memory.

Gaius, gā'yŭs, the name of several persons mentioned in history: (1) A Roman general, the son of Marcus Agrippa and Julia, daughter of Augustus Cæsar. He was adopted by Augustus and distinguished himself as a soldier during the 1st century B.C., having reduced Armenia and routed Tigranes. (2) A Roman jurist who lived 130 to 180 A.D. Before the revision of the Roman law and the reform of legal studies by Justinian, the 'Institutes' of Gaius, afterward the groundwork of the 'Institutes' of Justinian, were the received text-books of the schools of law. Almost completely lost until 1816, their discovery at Verona by Niebuhr threw a flood of light on the history of the early development of Roman law. (3) A Christian controversialist of the 3d century. He regarded the Epistle of Saint Paul to the Hebrews as apocryphal, and was the first who wrote against Cerinthus and the Millenarians. (4) Gaius, Saint, bishop of Rome, 283 to 296; d. 21 April 296. A native of Dalmatia and nephew of Diocletian, he suffered many hardships during the first persecution of the Christians by the emperor.

Galabat, gä-lä-bät', or **Kalabat,** Africa, a small district situated near the western frontiers of Abyssinia. The people, some 20,000 in number, and fanatical Mohammedans, trade with Abyssinia in coffee, cotton, hides, and beeswax. The district contains about 1,500 square miles.

Galac'tic Circle, the great circle of the heavens which coincides best with the course of the Galaxy or Milky Way. According to Sir John Herschel, the north pole of this great circle is situated approximately in right ascension 12 hours 47 minutes, and declination $+27°$, the circle crossing the equator at the points whose right ascensions are about 6 hours 47 minutes and 18 hours 47 minutes. See Galaxy.

Galac'tin, or **Galactine,** in chemistry, a nitrogenous substance obtained from milk by first precipitating the casein with acetic acid; coagulating the albumen by boiling, removing the fat by ether, concentration, filtration from earthy phosphates, allowing the milk-sugar to crystallize out, and finally precipitating the galactin by alcohol. Thirty-five parts of dried milk yield one part of galactin, which is soluble in water, insoluble in alcohol and ether. It is precipitated by tannin, but differs from gelatine in redissolving at 60°. Galactin emulsifies fat. It is found in the blood, gastric juice, animal membranes, milk, eggs, and many morbid animal fluids. It also exists in the juices of edible plants and in the fluid of the embryonal cotyledons.

Galago, ga-lā'gō, a genus of African lemurs (q.v.), arboreal and nocturnal in habit, living on fruit and insects. They vary from the size of a rabbit to that of a rat, are covered with soft fawn-gray woolly fur, have somewhat bushy tails longer than the body, and hind legs longer and stronger than the arms, with two of the ankle bones (*calcaneum* and *navicular*)

greatly elongated. The head is round like a cat's; the eyes are large with oval pupils contracting in daylight to vertical slits; the ears are naked and very big, expanded during activity, but rolled together when the animal rests. The female is said to bear one young one at a birth, and often carries it about. Soft nests are also made in the branches. The galago proper (*G. senegalensis*) seems to be distributed throughout tropical Africa, and is known in Senegal as "the gum animal" from its frequent habitat in mimosa or gum-acacia forests, and from its alleged habit of gum-chewing. It is said to be eaten there. The largest species (*G. crassicaudatus*) measures a foot in length, not including the bushy tail, which is 15 or 16 inches more. In Zanzibar the komba (*G. agisymbanus*) is said frequently to make itself intoxicated with palm-wine, so that it falls from the tree and gets caught. It is readily tamed and utilized to catch insects and mice in the houses. There are numerous species, and the Madagascar genera *Chirogale, Microcebus* and *Opolemur* are joined with it in the sub-family galaginæ. Consult Beddard, 'Mammalia' (1902).

Gal'ahad, Sir, the noblest of the Knights of the Round Table, of whom he alone was successful in the search for the Holy Grail. He was introduced into the Grail legend by Walter Map (q.v.). See Grail; Round Table, Knights of.

Gal'angal, a dried rhizome obtained from different species of *Alpinia* growing in the East. What is known as the lesser galangal is brought from China. It occurs in small pieces, cylindrical and forked, striated, and diversified with whitish rings; the outside is brown, the inside paler. It has an aromatic taste and odor, and is an agreeable substitute for ginger in dyspepsia. It yields an oil and a soft resin, but its chemical composition is not settled. The larger or Java galangal is coarser, and is not so strongly aromatic. The rhizome of *Alpinia officinarum* has been used in medicine as a stimulant aromatic.

Galan'thus. See Snowdrop.

Galápagos (găl a pā'gōs) **Archipelago,** a group of volcanic islands in the Pacific Ocean, belonging to the Republic of Ecuador. (For population, etc., see Ecuador.) Features of wholly exceptional interest in the natural history of the archipelago were noted by Charles Darwin in his 'Journal of the Voyages of the Beagle,' which forms the basis of the present description. The archipelago consists of 10 principal islands, of which 5 much exceed the others in size. They are situated under the equatorial line, and between 500 and 600 miles to the westward of the coast of Ecuador, and directly south of Guatemala. The constitution of the whole is volcanic; with the exception of some ejected fragments of granite every part consists of lava, or of sandstone resulting from the attrition of such materials. The higher islands (which attain an elevation of 3,000 to 4,000 feet) generally have one or more principal craters toward their centre, and on their flanks smaller orifices. There are, in all the islands, at least 2,000 craters. Though the islands are placed directly under the equator, the climate is not in all parts of them excessively hot; a circumstance which is owing to the singularly low temperature of the surrounding sea. Very little rain falls, except during one short season, but the clouds generally hang low; therefore the summits, at an elevation of 1,000 feet or more, possess a tolerably luxuriant vegetation, while the lower parts of the islands are extremely arid. On a part of Chatham Island, black cones, the former chimneys of the subterranean heated fluids, are so numerous and in form so regular that they give the country a "workshop" appearance, which strongly reminded Mr. Darwin of the great iron foundries of Staffordshire. All the craters on Chatham are extinct, but on the western islands "the volcanic forces were in frequent activity." Charles Island was frequented by buccaneers and whalers long before Ecuador established a small penal colony there (1829–30). The soil of the elevated portions of that island is fertile black mud; the climate of the same regions is tempered by a cool southerly tradewind; and wild pigs and goats are found in the woods, "but the main article of animal food is derived from the tortoises"— which sometimes weigh 200 pounds each. On both Albemarle and Marlborough islands, eruptions occasionally take place. Of the former, Mr. Darwin writes: "I should think it would be difficult to find in any other part of the world an island situated within the tropics, and of such considerable size (namely, 75 miles long), so sterile and incapable of supporting life." On James Island there is a lake from which salt is procured. The equatorial heat was observed in its effect upon the soil of the lower and sterile parts. There the thermometer placed in sand of a brown color immediately rose to 137°, and black sand was so much hotter that it was disagreeable to walk over, even in thick boots. An acacia, a cactus, and one of the euphorbiaceæ — a bush with minute brown leaves — are common in some parts of these lowlands. Near the summits the vegetation has a very different character; ferns and coarse grasses are abundant; and the commonest tree is one of the Compositæ. There are no members of the palm family. "The natural history of this archipelago," Mr. Darwin says, "is very remarkable. It seems to be a little world within itself; the greater number of its inhabitants, both vegetable and animal, being found nowhere else." And again, "In my collections from these islands there are 26 different species of land birds. With the exception of one, all probably are undescribed kinds, which inhabit this archipelago and no other part of the world." The order of reptiles forms the most striking feature in the zoology of the islands, the species not being numerous, but the number of individuals of each kind extraordinarily great. There is one kind both of the turtle and tortoise; of lizards four; and of snakes about the same number. Of the tortoise (*Testudo Indicus*) some old males have been found so large that it required six or eight men to lift them from the ground. Mr. Darwin says: "I frequently got on their backs, and then, upon giving a few raps on the hinder part of the shell, they would rise up and walk away; but I found it very difficult to keep my balance. The tortoise is very fond of water, drinking large quantities, and wallowing in the mud. The larger islands alone possess springs, and

these are always situated toward the central parts, and at a considerable elevation. The tortoises, therefore, which frequent the lower districts, when thirsty, are obliged to travel from a long distance. Hence broad and well-beaten paths radiate off from the wells even down to the seacoast. Near the springs it was a curious spectacle to behold many of these great monsters; one set eagerly traveling onward with outstretched necks, and another set returning, after having drunk their fill." Mr. Darwin inclines to the opinion that the Galápagos islands are the original home of the *Testudo Indicus,* though it is now found in many parts of the world. Also characteristic of this archipelago are the lizards, individuals of the aquatic variety, being 3 or 4 feet long. Many of the islands possess trees, plants, and birds, which do not occur on the others. At the date of Mr. Darwin's visit the birds had not learned to fear man. He writes: "A gun is here almost superfluous; for with the muzzle of one I pushed a hawk off the branch of a tree."

MARRION WILCOX.

Galata, gä'lä-tä, a suburb of Constantinople (q.v.).

Galatea, găl-a-tē'a, in mythology, daughter of Nereus and Doris. The Cyclops Polyphemus persecuted with his love this charming nymph, though he gained nothing but ridicule in return. The handsome shepherd Acis, of Sicily, enjoyed her affection, and suffered death on her account; for Polyphemus, finding them together, and mad with jealousy, hurled a rock at them, which dashed Acis in pieces, while Galatea escaped into the sea. Acis was transformed into a fountain, and hastened to meet his mistress in a safer region.

Galatia, gā-lā'shĭ-a, Asia Minor, the ancient name of an extensive region, so called from its Gallic inhabitants, who were immigrants from Europe. With the Gauls were intermingled a considerable proportion of Greeks; hence the inhabitants were often called Gallogræci, as well as Galatians.

Gala'tians, Epistle to the, one of the epistles of St. Paul, the genuineness of which has never been questioned by a critic of the first rank. The internal evidence is incontrovertible. No forger would have ventured on the admissions made by the writer; no false Paul would have allowed that Paul's apostleship was doubted and his successes discredited. The occasion of the letter seems to have been as follows: At his first visit St. Paul experienced a most favorable reception from the Galatians, who exhibited a strong personal attachment to him (Gal. iv. 14). After his departure the judaizing teachers commenced their work, and on the Apostle's second visit he found the noxious influence taking effect. During his short sojourn he endeavored, by oral instruction, to meet the evil; but learning after his departure to Ephesus that his converts were again lapsing from the faith, he addressed to them this indignant warning. This epistle has been often commented upon. Consult: Winer (1829), Ruckert (1833), Usteri (1833), Meyer (1851), Ellicott (1867), Lightfoot (1887), Findlay (1889), and Drummond (1893).

Gal'ba, Servius Sulpicius, Roman emperor: b. 3 B.C.; d. 15 Jan. 69 A.D. Caligula appointed him general in Germany. He soon repulsed the Germans who had invaded Gaul, and restored the ancient military discipline. After the death of Caligula he caused his troops to swear allegiance to Claudius, who sent him in 45 A.D. as proconsul to Africa, where great confusion prevailed. In two years Galba restored order, obtained the honors of a triumph, and was received among the priests of Augustus. Nero appointed him in 61 A.D. governor of Hispania Tarraconensis, but soon after became so exasperated against him that he ordered him to be secretly assassinated. Galba then revolted, but when news arrived of the insurrection among the prætorians at Rome, and of the death of Nero, 68 A.D., he himself was chosen emperor by the prætorian cohorts in Rome. Ambassadors from the senate made known to him his elevation. He chose a colleague in the government under the name of an adopted son, but instead of Otho, favored by the soldiery, he selected Piso Licinianus, hated by them on account of his rigid virtue. Otho, offended by this neglect, resolved to get possession of the throne by force of arms. The prætorian cohorts first declared themselves in his favor, and Galba, attempting in vain to restore order, was attacked and slain.

Gal'banum, a gum-resin obtained from *Ferula galbaniflua* and allied plants, used in medicine as a carminative and expectorant, and externally as an irritant.

Gale, a tree. See CANDLEBERRY.

Gale College, a coeducational institution in Galesville, Wis., founded in 1844 under the auspices of the Presbyterian Church. It has 10 professors and instructors; 120 students; volumes in the library, 10,000; productive funds, $20,000; benefactions, $2,000; grounds and buildings valued at $30,000; income, $4,500; number of graduates, 700; president, William D. Thomas.

Ga'len, or Claudius Galenus, Greek physician: b. Pergamus, Mysia, 131 A.D.; d. Sicily about 201 A.D. He began the study of medicine at Pergamus, and afterward studied at Smyrna, Corinth, and Alexandria. On his return to his native city in 158 he was appointed physician to the school of gladiators. Six years later he went to Rome, where he stayed four years, and gained wide reputation. Scarcely had he returned to his native city when he received a summons from the Emperors M. Aurelius and L. Verus to attend them in the Venetian territory, and shortly afterward he accompanied them to Rome. There he remained several years, though how long is not known precisely, and about the end of the 2d century was employed by the Emperor Severus. Galen was a voluminous writer not only on medical, but also on philosophical subjects, such as logic, ethics, and grammar. The works that are still extant under his name consist of 83 treatises, acknowledged to be genuine; 19 whose genuineness has been questioned; 45 undoubtedly spurious; 19 fragments; and 15 commentaries on different works of Hippocrates. His most important anatomical and physiological works are: 'Of Anatomical Administrations' and 'Of the Use of the Parts of the Human Body.' As an anatomist, he combined with patient skill and sober observation as a practical dissecter — of lower animals, not of the human body — accuracy of description and clearness of exposition as a writer. He

gathered up all the medical knowledge of his time and fixed it on such a firm foundation of truth that it continued to be, as he left it, the authoritative account of the science for centuries. His physiology does not, according to modern ideas, attain the same level of scientific excellence as his anatomy. He seems to place a more implicit faith in amulets than in medicine, and he is supposed by Cullen to be the originator of the anodyne necklace which was so long famous in England. The best modern edition of Galen's works is by Kühn (1821–33).

Galena, Ill., a city and county-seat of Jo Daviess County, a port of entry on the Galena River, and on the Illinois C.; Chicago, B. & Q., and the Chicago & N. W. R.R.'s, 17 miles from Dubuque. Galena is famous as the home of Gen. U. S. Grant (q.v.) from May 1860 until the opening of the Civil War, and the old Grant homestead still remains one of the attractions of the city. There is here Grant Park, a fine statue of Gen. Grant, a United States customs house, government building, and a public library. The city has an extensive trade by rail and river, and is the centre of large lead and zinc mining interests. There are also smelting works, shoe factories, and other industries. The town, which was named after the galena ore found in the vicinity, was settled in 1827 and incorporated as a city in 1839. The mayor and council are elected every two years. The city owns its electric light plant. Pop. (1900) 5,005.

Galena, Kan., a city in Cherokee County, on the Kansas City, Ft. S. & M., and the St. Louis & S. F. R.R.'s; 7 miles west of Joplin, Mo. It is noted principally for its remarkable growth during 10 years, 1890 to 1900. Like its namesake in Illinois, Galena is engaged largely in lead and zinc mining and smelting. The mining district, about 4 miles square, has 200 concentrating mills, and gives employment to 3,000 men. Over $5,000,000 in ore was mined in 1900. The mayor and council are elected every two years. The deputy marshal and police are appointed by the council. Galena was settled and incorporated in 1877, and its population rapidly increased, as follows: (1880) 1,463; (1890) 2,496; and (1900) 10,155.

Galena, a sulphide of lead (PbS), containing when pure 86.6 per cent lead. It crystallizes in the isometric system, commonly in cubes or cubo-octahedrons, but is often found massive with a well-marked and characteristic cubic cleavage. It has a metallic lustre and lead-gray color. Its hardness is 2.5 and its specific gravity 7.5. Galena is the most important ore of lead, nearly all the world's supply of that metal being obtained from it. As it is always more or less argentiferous the mineral is frequently an important silver ore, the amount of silver present sometimes amounting to over 1 per cent, but galena containing less than 1 per cent silver is often mined as a lead-silver ore. The mineral is widely distributed, frequently being associated with the sulphides of iron, copper, or zinc, and often with native gold. The principal mines working deposits of galena in the United States are in Missouri, Colorado, Idaho, Utah, and Montana. See LEAD; SILVER.

Galenists, gā'lĕn-ĭsts, a religious sect founded by Galen or Galenus Abrahans de Haan. They were a branch of the Mennonites. Galen was a doctor of medicine and a minister among the Mennonites at Amsterdam. He taught freer doctrine in practice and belief than his co-religionists, declaring that the Christian religion was not so much a body of truths to be believed as of principles to be obeyed. His enemies accused him of having Socinian proclivities, a charge from which the States-General acquitted him 14 Sept. 1663.

The term was also in medical controversy during the Renaissance to mean a follower of Galen, whose authority as a physician they maintained against the introduction of new chemical methods into the preparation of medicinal drugs. The new school professed to extract essences, or quintessences, and like modern homœopathists gave doses small in bulk, but alleged to be powerful in effect, as containing a concentrated preparation of the original drug. The Galenists adhered to the ancient tinctures and extracts, which, they maintained, possessed all the virtues necessary.

Galerites, găl-ẹ-rī'tēz, a genus of fossil sea-urchins, peculiar to and abundant in the Cretaceous system. The body in breadth is nearly circular or polygonal. The under surface is entirely flat, and has the mouth placed in its centre, with the vent near the margin. There are five avenues of pores reaching from the mouth to the summit. These fossils are often found silicified. *G. albogalerus* is one of the most abundant; it has received its specific name from its resemblance to the white caps worn by the priests of Jupiter.

Galerius, gă-lē'rĭ-ŭs, or **Galerius Valerius Maximianus,** Roman emperor: b. near Sardica, Dacia; d. 311 A.D. Entering the imperial army, he rose rapidly to the highest ranks. In 292 Diocletian conferred on him the title of Cæsar and gave him his daughter in marriage. On the abdication of Diocletian (305) he and Constantius Chlorus became joint rulers of the Roman empire, Galerius taking the east half. When Constantius died in York (306) the troops in Britain and Gaul immediately transferred their allegiance to his son, Constantine (afterward Constantine the Great). Galerius, however, retained possession of the East till his death.

Gales, Joseph, American journalist: b. Eckington, England, 10 April 1786; d. Washington, D. C., 21 July 1860. He came to the United States with his father in 1793, was educated at the University of North Carolina and learned the printer's trade of his father. In 1807 he was made assistant and later partner of Samuel Harrison Smith in the management of the 'Independent Gazetteer,' which had been removed to Washington and its name changed to the 'National Intelligencer.' He became sole editor of that paper in 1810, and took his brother-in-law, William Winston Seaton, into partnership in 1812. Had it not been for the industry of Gales and Seaton an important part of the proceedings of the Senate and House of Representatives, which they reported, would not have been preserved. Especially is this true of the great debate between Hayne and Webster.

Galesburg, Ill., a city and county-seat of Knox County, on the Atchison, T. & S. F.; the Chicago, B. & Q., and Chicago & N. W. R.R.'s, 43 miles northeast of Burlington, Iowa. This

is the seat of Knox College, founded in 1837, where took place the famous Lincoln-Douglass debate in 1859. Lombard University (Universalist) was established here in 1852, and the St. Joseph Academy and the Ryder Divinity School are also located here. There is a public library containing 24,000 volumes. The Burlington railroad shops give employment to many mechanics, and there are extensive stock-yards, brick-making plants, boiler and engine works, farm machinery works, and carriage factories. Under a general State law, passed in 1872, the mayor and city council are elected every two years, and the smaller offices are filled by appointments made by the mayor with consent of the council. The town was settled in 1837 by pioneers from New York State, and named in honor of Rev. George W. Gale, who planned to establish a theological seminary here. During the Kansas-Nebraska struggle Galesburg was a rendezvous and rallying point for the free-soilers. The city was chartered in 1857. The municipality owns and operates its electric light and water plants. Pop. (1900) 18,607.

Galesville, Wis., a village in Trempealeau County, on the Chicago & N. R.R.; 15 miles east of Winona. It is the seat of Gale College (Presbyterian). Pop. (1900) 862.

Gali, Francisco, frän-thēs'kō gä'lē, Spanish navigator: b. Seville 1539; d. Mexico City 1591. He sailed from Acapulco in 1585 with two vessels, under commission of Pedro Moya de Contreras, provisional viceroy of New Spain, to look for a harbor on the coast of California where ships returning from the East Indies might be restocked with provisions. He visited the Philippines, Macao, the Lin-Kins, Japan, and other islands, and on his return (1584) discovered what is now the Bay of San Francisco. The report of the voyage sent by him to the viceroy of the Indies was published by Linschot in a Dutch rendering in 'Track Charts of the Indies' (1596), and an English translation appears in Hakluyt's 'Voyages.' In the National Library, Mexico, are fragments of what is believed to have been a more extended narrative by Gali. He was a skilful navigator and acute observer.

Galicia, gă-lĭsh'ĭ-a, Austria, a crownland or province of Austria, composed of the kingdoms of Galicia and Lodomeria, the duchies of Auschwitz and Zator, and the grand-duchy of Cracow, and formerly including the duchy of Bukowina. It is bounded on the north, northeast and east by Russia, southeast by Bukowina, south by Hungary, and west by Moravia and a small portion of Prussian Silesia; area, 30,307 square miles; pop. (1900) 7,315,939. The physical features of the country are determined by the Carpathians, which form a long and irregular curve on the south, the convexity being toward Galicia. Farther north the hills subside and merge into vast plains. The chief river in the northwest is the Vistula, which partly bounds the province. The Western Bug, a tributary of the Vistula, is partly in Galicia. The chief river is the Dniester. The only part of the surface belonging to the basin of the Danube is in the southeast. It is drained by the Pruth, and is of limited extent. The climate is severe, particularly in the south, where more than one of the Carpathian summits are beyond the limit of perpetual snow. While Galicia is open to the cold north and east winds, these mountains intercept the warm winds from the south. The winters are long and rigorous, and the summers very warm, but comparatively short.

The soil is much diversified. In the more mountainous districts scanty pasture only is obtained, but in general, where the elevation is small, the ground, more especially where resting on a substratum of limestone, is of great fertility, and yields abundant crops of wheat, rye, barley, oats, and maize. Hemp, flax, and tobacco are also extensively grown, and the sugar beet is cultivated. The domestic animals include great numbers of horned cattle, generally of a superior description, and a fine hardy breed of horses, well adapted for cavalry. Sheep are neglected; but goats, swine, and poultry abound. The rearing of bees yields great quantities of wax and honey, and is a lucrative industry. Bears and wolves are frequently met with in the forests, and all the lesser kinds of game are in abundance. The minerals include marble, alabaster, copper, lead, zinc, calamine, coal. iron, and rock-salt. Only the last two are of much importance. Iron occurs in numerous parts of the central Carpathian chain, and bog-iron ore is frequently met with in extensive seams on the plains. They are both worked to a considerable extent. Rock-salt is particularly abundant, stretching in continuous beds for nearly 250 miles along the base of the Carpathians, and of course beyond the limits of Galicia, into Bukowina and Transylvania. The most important mines have their central locality at Wieliczka. Manufactures have not made much progress. The spinning and weaving of flax and hemp prevail to a considerable extent on the confines of Silesia. Distilleries exist in every quarter. Tobacco, sugar, leather, beer, agricultural machinery, etc., are also manufactured. The principal exports are salt, wood, grain, coal, aniseed, linen and spirits. The population is generally of Slavonian origin, and consists of two principal branches — Polish in the west and Russniak in the east. In religion they are divided among Roman Catholics, Greek Catholics, and Armenians. The number of the Jews is considerable. The court of third instance for the country is the superior court at Vienna; there are two courts of second instance, one at Lemberg and the other at Cracow; and there are various district courts of first instance. The government has its headquarters at Lemberg. Educational establishments, both for superior and ordinary instruction, are numerous. At the head of the former stand the University of Cracow, with about 130 instructors and some 1,300 students, and the younger university of Lemberg, with 80 instructors and a similar attendance. The principal towns are Lemberg, the capital, Brody, Cracow, Stanislau, Tarnopol, Przemysl, Sambor, etc.

The nucleus of the modern kingdom of Galicia and Lodomeria was formed by the duchies of Halicz and Vladimir (the original forms of the present names), which were established about the beginning of the 12th century under two princes of the Russian dynasty of Rurik.

After being the field of continuous strife between Russians, Poles, and Hungarians, Galicia continued a Polish dependency from 1382 till the first partition of Poland, in 1772, when it was

acquired by Austria. Galicia is now one of the Cis-Leithan provinces of the Austrian empire, and is represented in the Reichsrat by 63 deputies, while the affairs peculiar to itself are deliberated and determined on by its own Landtag or Diet. Polish is the language of official intercourse and of the higher educational institutions.

Galicia, Sp. gä-lē'thē-ä, Spain, an ancient kingdom and province, bounded north and west by the Atlantic, south by Portugal, and east by Leon and Asturias, with an area of 11,340 square miles. It has been divided since 1833 into the minor provinces of Coruña, Lugo, Orense, and Pontevedra, whose joint population in 1900 was 2,073,618. The country is mountainous, being traversed by offsets of the Asturian chain, rising in their highest peaks to about 6,500 feet. The west spurs, Capes Ortegal and Finisterre, project into the Atlantic. The numerous short but rapid rivers form small estuaries which afford secure havens and roads. The principal river is the Minho, which, with its feeder the Sil, is navigable for small vessels on its lower course. Galicia has a mild, nourishing climate, but agriculture is in a backward condition, capital is scarce, roads are bad, and railways are few. Rich meadows and dense forests occur everywhere, but the soil is more suited to the cultivation of garden produce than of corn. Mines of lead, tin, copper, and iron pyrites are worked. The inhabitants, called Gallegos, are a robust, vigorous, industrious race. Great numbers of them annually visit central and southern Spain and Portugal, where they find employment as harvesters, water carriers, porters, etc. Chief exports, live cattle, preserved meat, eggs, minerals, fish, fruits, and grain; imports, coal, oil, hides, spirits, sugar, and tobacco. The principal towns are Santiago di Compostella and the two strongly fortified seaports Coruña and Ferrol. Galicia was a kingdom under the Suevi from 411 to 585, and again from 1060 to 1071, at which date it was finally incorporated with Leon and Castile.

Galignani, gä-lēn-yä'nē, **John Anthony,** English journalist: b. London, England, 13 Oct. 1796; d. Paris 31 Dec. 1873. He was taken by his father to Paris in the latter part of 1798, and succeeded him in publishing the weekly paper 'Galignani's Messenger,' which had become popular among the English residents of Paris. He remained a subject of Great Britain during his life, and was very liberal to the charitable institutions of that country. His brother, William (b. London 10 March 1798; d. Paris 12 Dec. 1882) was associated with him in the management of the 'Messenger,' and in the building of a hospital in Neuilly for indigent English people. In his will he provided money and land for the erection in Neuilly of the Galignani Brothers' Retreat for 100 printers, booksellers, etc., or their families.

Galile'an, one of the followers of Judas the Gaulonite, who resisted the payment of the tax imposed by Quirinius, the Cyrenius of St. Luke (Luke ii. 1), and gave the Romans trouble till the capture of Jerusalem by Titus in 70 A.D. Galileans is a name applied to Jesus and his disciples, from the intimate connection they had with Galilee (Matt. xxvi. 69; Mark xiv. 70); hence applied by pagans and Mohammedans, as a term of reproach to Christians generally.

Gal'ilee, Palestine, during the Roman period and at the commencement of the Christian era, a province comprehending the northern part of Palestine, west of the Jordan. In pre-Roman times it was referred to as a district inhabited by the tribe of Naphtali. Its name is derived from the Hebrew *galil,* signifying a circle or circuit. It now forms part of the pashalic of Damascus, in the Turkish province of Syria. Anciently it was divided into Upper and Lower Galilee, and was a fertile region with many towns and villages, thickly inhabited by Syrians, Phœnicians, Arabs, Greeks, and Jews. The Jewish inhabitants, on account of their ignorance, simplicity of manners and less rigid sentiments in regard to religion, were held in contempt by other Jews; but after the destruction of Jerusalem despised Galilee became the refuge of the doctors of Jewish law, and the city of Tiberias the seat of Rabbinical learning. As the cradle of Christianity and the scene at Nazareth, Cana, Capernaum, the Lake of Gennesaret, Mount Tabor, and other localities, of a great deal of Christ's ministry on earth, Galilee has worldwide interest. Consult: Merrill, 'Galilee in the Time of Christ' (1885).

Galilee, Sea of, in biblical history also called the Sea of Chinnereth or Cinneroth, Lake of Gennesaret and Sea of Tiberias, is a large pear-shaped lake in the north of ancient Galilee (q.v.), Palestine. It lies 682.5 feet below sea-level; is 13 miles long by 6 broad, and 820 feet deep. It occupies the bottom of a great basin, and is of volcanic origin. The Jordan flows into it red and turbid from the north, and it is fed also by many warm and brackish springs, but its waters are cool, clear, and sweet. Its shores on the east and north sides are bare and rocky; on the west gradually sloping, and luxuriantly covered with vegetation. On its shores are Bethsaida, Capernaum, Magdala, and Tiberias.

Galilei, Galileo, gä-lē-lā'ō gä-lē-lā'ē, Italian astronomer: b. Pisa 14 Feb. 1564; d. Arcetri 8 Jan. 1642. His father, Vincenzo Galilei, a nobleman of Florence, caused him to be instructed in the ancient languages, drawing, and music, and he very early showed a strong inclination to mechanical labors. In 1581 Galileo entered the University of Pisa, to attend lectures on medicine and the Aristotelian philosophy. That spirit of observation for which he was distinguished was early developed. When only 19 the swinging of a lamp suspended from the ceiling of the cathedral in Pisa led him to investigate the laws of the oscillation of the pendulum, which he was the first to apply as a measure of time. He studied mathematics under Ostilio Ricci, soon exhausted Euclid and Archimedes, and was led, by the works of the latter, in 1586, to the invention of the hydrostatic balance.

He now devoted his attention exclusively to mathematics and natural science, and in 1589 was made professor of mathematics in the University of Pisa. In the presence of numerous spectators he went through with his experiments, which he performed on the tower of the cathedral, to show that weight has no influence on the velocity of falling bodies. By this means he excited the opposition of the adherents of Aristotle to such a degree, that after two years he

was forced to resign his professorship. Later he became acquainted with Francesco Sagredo, a Venetian, upon whose recommendation the Senate of Venice, in 1592, appointed him professor of mathematics in Padua. He lectured here with unparalleled success. Scholars from the most distant regions of Europe crowded about him. In 1597 he invented the sector.

One of the most important mathematical discoveries which he made at a period subsequent to this is that the spaces through which a body falls, in equal times, increase as the numbers 1, 3, 5, 7; that is, if a body falls 16 feet in the first second, it will fall 48 in the next second, 80 in the third, and so on. Whether the thermometer was his invention it is difficult to determine; perhaps he only improved it. He made some interesting observations on the magnet, and by means of the telescope in a short time made a series of the most important discoveries. He found that the moon, like the earth, has an uneven surface; and he taught his scholars to measure the height of its mountains by their shadow. A particular nebula he resolved into individual stars, and even conjectured that the whole Milky Way, with good instruments, might be resolved in the same manner. His most remarkable discovery was that of Jupiter's satellites, 7 Jan. 1610. He likewise observed Saturn's ring, though he had not a just idea with regard to it. He saw the sun's spots somewhat later, and inferred, from their regular advance from east to west, the rotation of the sun, and the inclination of its axis to the plane of the ecliptic.

Galileo's name, meantime, had grown so celebrated that Cosmo II., grand-duke of Tuscany, appointed him grand-ducal mathematician and philosopher, and invited him to become first instructor in mathematics at Pisa. Here he gained a decisive victory for the Copernican system by the discovery of the varying phases of Mercury, Venus, and Mars; as the motion of these planets about the sun, and their dependence on it for light, were thus established beyond the possibility of doubt. He wrote a work afterward on the floating and sinking of solid bodies in water, and in this, as well as in all his other writings, scattered the seeds of many new doctrines.

While thus employed in enlarging the field of natural philosophy, a tremendous storm was gathering about his own head. He had declared himself in favor of the Copernican system, in his work on the sun's spots, and was therefore denounced as a heretic by his enemies. In 1611 he visited Rome for the first time, where he was honorably received, and where a favorable report was made on his writings by the mathematicians of the Collegio Romano at the instance of Cardinal Bellarmin. On his return to Florence, however, he became more and more involved in controversy, which gradually took a theological turn, and in the course of which he declared the literal understanding of the utterances of Scripture with regard to physical phenomena to lead to absurdities. From Rome he received, in the name of the Cardinal Barberini (afterward Pope Urban VIII.) the warning not to overstep the limits of mathematics and physics, but he paid no heed to the well-meant advice. The monks preached against him, and in 1616 he found himself again obliged to proceed to Rome, where he is said to have pledged himself to abstain for the future from promulgating his system either orally or otherwise. The genuineness of the document on the basis of which this is asserted, has, however, been questioned in modern times, and the controversy regarding this matter is not yet finally settled.

In 1618 the appearance of three comets gave him an opportunity to communicate to his friends some general observations on these bodies. His scholar, Mario Guiducci, wrote a work immediately after, in which he severely condemned the Jesuit Grassi. Supposing Galileo to be the author, Grassi attacked him. Galileo replied in his 'Saggiatore,' a masterpiece of eloquence, pronounced by Algarotti to be the finest controversial work Italy has ever produced, and, notwithstanding the errors contained in it, a work always worthy to be read.

About this time he completed his famous work, in which, without giving his own opinion, he introduces three persons in a dialogue, of whom the first defends the Copernican system, the second the Ptolemaic, while the third appears as a blind and unreasoning supporter of the views of Aristotle. With this work, in which the greatest elegance and accuracy of style is united with the clearest and most concise statements, Galileo went to Rome in 1630, and succeeded in obtaining the privilege to print it. Having obtained the same permission in Florence, he published it there in 1632 — 'Dialogo di Galileo Galilei, dove ne' Congressi di quattro Giornate si discorre de' due massimi Sistemi, Tolemaico et Copernicano.' Scarcely had it appeared when it was attacked by the disciples of Aristotle, and most violently of all by Scipione Chiaramonti, teacher of philosophy at Pisa. A congregation of cardinals, monks, and mathematicians examined his work, condemned it as highly dangerous, and summoned him before the tribunal of the Inquisition. The veteran philosopher was compelled to go to Rome, and in June 1633 was condemned to renounce, in presence of a great assembly, kneeling before them, with his hand upon the Gospel, the great truths he had maintained. "Corde sincero et fide non ficta, abjuro, maledico et detestor supradictos errores et hereses," was the formula which he was compelled to pronounce. Upon this he was sentenced to the dungeons of the Inquisition for an indefinite time, and every week, for three years, was to repeat the seven penitential psalms of David. His 'Dialogo' was prohibited, and his system condemned as contrary to the Bible. His judges were merciful enough to commute his sentence of imprisonment to banishment to the villa of the Grand-duke of Tuscany at Rome, then to the archiepiscopal palace at Sienna, and soon after he was allowed to return to Arcetri, not far from Florence.

He employed his last years here principally in the study of mechanics and projectiles. The results are found in two important works on the laws of motion, the foundation of the present system of physics and astronomy. At the same time he tried to make use of Jupiter's satellites for the calculation of longitudes; and though he brought nothing to perfection in this branch, he was the first who reflected systematically on such a method of fixing geographical longitudes. He was at this time afflicted with a disease in his eyes, one of which was wholly

blind, and the other almost useless, when, in 1637, he discovered the libration of the moon. Blindness, deafness, want of sleep, and pain in his limbs united to embitter the last years of Galileo's life. He died in the year Newton was born, and his relics were ultimately deposited in the Church of Sta. Croce, at Florence, where a splendid monument was erected to him near that of Michelangelo.

Galileo was of diminutive size, but strong and healthy. His countenance was agreeable; his conversation lively. He loved music, drawing, and poetry. He knew Ariosto by heart; and in one of his works, first printed in 1793, 'Considerazioni al Tasso,' the product of his leisure hours, he points out the superiority of Ariosto to Tasso, whom he criticises very severely. His style is lively, natural, and fluent. His collected works have been edited by Alberi (16 vols. 1842–56). Consult: Nelli, 'Vita e Commercio Litterario di Galilei' (1821); Brewster, 'Martyrs of Science' (1841); Chasles, 'Galileo Galilei' (1862); L'Epinois, 'Les pièces du procès de Galilée' (1877); L'Epinois, 'La question de Galilée' (1878); 'Galileo Galilei und die Römische Kurie' (1876), Gebler; 'Die Akten des Galileischen Processes' (1877); Favaro, 'Galileo Galilei' (1882); Scarbazzini, 'Galileo Galilei' (1883); Wegg-Prosser, 'Galileo and his Judges' (1889).

Galimberti, Luigi, loo-ē'jē gä-lēm-bãr'tē, Italian cardinal and diplomat: b. Rome 1838; d. 1896. He became professor of church history in the College of the Propaganda and of theology in the University of Rome, and was appointed by Pius IX. canon of the Lateran in 1868. From Leo XIII. he received appointment as canon of Saint Peter's, archbishop of Nicæa, and secretary to the Congregation of Extraordinary Ecclesiastical Affairs. He was papal arbiter in the award to Spain, as against Germany, of the Carolines, and in 1880 was sent as ambassador to Germany, where he was successful in adjusting the difficulties of the "Kulturkampf" through the abrogation by the crown of the so-called "May Laws." In 1893 he was made a cardinal and prefect of the papal archives.

Gal'ion, Ohio, a city in Crawford County, on the Erie and the Cleveland, C., C. & St. L. R.R.'s, 81 miles southwest of Cleveland. Galion is an important railroad town, being a connecting point and division terminal. There are railroad shops and round-houses here, brick and tile works, carriage and wagon factories, wheel and gear works, iron foundries, and lumber-mills. The town was originally laid out in 1831, by settlers from western Pennsylvania, and was chartered as a city in 1878. The city owns and operates its electric light and water plants. The government is composed of a mayor, who holds office for two years, and a common council, elected by popular vote. Pop. (1900) 7,482.

Galitzin. See GALLITZIN.

Gall, Saint, Irish monk: b. Ireland about 550; d. Saint Gall, Switzerland, about 645. He accompanied Saint Columba to France about 585, and took part with him in all his missionary labors. Banished from France, they went together into the wilder regions of Switzerland, and near the Lake of Constance they founded the monastery which bore the name Saint Gall and gave name to the town and canton of Saint Gall. After a few years Columba retired to Italy, leaving his companion abbot of the new house. The monastery was burnt by Hungarians in the 10th century.

Gall, Franz Joseph, fränts yō'sĕf gäl, German phrenologist: b. Tiefenbronn, Baden, Germany, 9 March 1758; d. Montrouge, near Paris, 22 Aug. 1828. He studied medicine at Strasburg and Vienna, and settled in the latter city in 1785 as a physician. In 1796 he began to give courses of lectures on phrenology (q.v.) in Vienna; but these lectures were prohibited in 1802 by the Austrian government as being subversive of the accepted religion. With Spurzheim, who became his associate in 1804, he quitted Vienna in 1805, and began a lecturing tour through Germany, Holland, Sweden, and Switzerland. He reached the height of his fame when in 1807 he settled as a physician in Paris. On March 14, 1808, he and Spurzheim presented to the Institute of France a memoir of their discoveries, on which a committee of the members of that body (including Pinel, Portal, and Cuvier) drew up an unfavorable report. Thereupon Gall and Spurzheim published their memoir, 'Introduction to Physiology of the Brain'; this was followed by 'Researches on the Nervous System' (1809); and by 'Anatomy and Physiology of the Nervous System' (1810–19) with an atlas of 100 plates. In 1811, in answer to accusations of materialism and fatalism brought against his system, Gall published 'Of the Innate Inclinations of the Soul and Spirit.' He continued to practise medicine and pursue his researches at Montrouge, near Paris, till his death. See SPURZHEIM, KASPAR.

Gall. See BILE.

Gall-bladder, a pear-shaped bag, attached to the under surface of the liver, the function of which is the storage of bile. It is about four inches long and two inches in diameter at the widest part. It will hold from an ounce to an ounce and a half of fluid. The broad end almost reaches the abdominal wall under the edge of the liver at the border of the ribs, about three inches from the middle line of the body. From a groove on the under surface of the liver two ducts that collect secretion from all parts of the organ join and pass down to the duodenum. The gall-bladder is connected with this common duct by another duct or canal of the same structure. They are all about the size of a quill, but are capable of being distended. Bile is not poured out into the intestine unless the chyme from the stomach passes over the mouth of the duct, but the bile travels down the ducts from the liver, and back through the cystic duct to be stored in the gall-bladder until needed.

Acute catarrhal cholangitis is an acute inflammation of the lining membrane of the ducts, causing swelling of the membrane and obstruction to the outflow of bile. The process is usually an extension of an acute gastritis and duodenitis. Jaundice results from the obstruction to the passage of bile, and aside from this the disease presents the picture of acute gastritis. Three to five weeks usually elapse before the jaundice disappears. Chronic cholangitis is due to the presence of stones, to stricture, to carcinoma, or the pressure on the outside. There is nothing distinctive in its evidences.

Acute cholecystitis is due to infection of the gall-bladder from the intestines by various microbes. It is usually associated with the presence of stones within the bladder. It may be a mere catarrh or may be suppurative, going on to perforation and peritonitis. The symptoms are violent pain, exquisite tenderness on the right side of the abdomen, and a high fluctuating temperature. Operation is usually demanded. Gall-stones, cholelithiasis, a disease attended by the formation of stones within the gall-bladder. These stones are formed chiefly of cholesterin, a normal constituent of the bile. It is held that previous infection and stasis of the bile in the bladder are essential to their formation. Large numbers may be formed and held in the gall-bladder for years without causing disturbance, but there is constant likelihood of inflammation, as well as attempts of the bladder to force out these stones. Stones may be passed directly through the ducts or at any point in the cystic or common duct find lodgment. If stones lodge in the cystic duct no bile can pass into the gall-bladder, but that already there may be added to by a mucous secretion, causing the bladder to distend. This condition is called hydrops of the gall-bladder. A stone lodging in the common duct dams back the bile and causes jaundice of pronounced type.

Hepatic colic is the name given to the intense cramp that accompanies the passage of a gall-stone through the bile-ducts or an attempt at such a passage. There is a sudden excruciating pain in the right side at the free border of ribs or even over the whole abdomen; frequently the pain may shoot up to the right shoulder-blade and arm. The patient rolls and tosses in agony with his face suffused with cold perspiration. Sometimes there is a chill followed by fever. The duration depends on the course of the stone; frequently relief is had in a few hours, only soreness remaining.

D. D. Roberts, M.D.,
Brooklyn, N. Y.

Gall-fly, one of the several minute gall-making insects, as the British ash-fly. See Galls and Gall-makers.

Gall-gnats, a gall-making gnat of the genus *Cecidomyia.* See Galls and Gall-makers.

Gall-stones. See Calculus.

Gal'la. See Nut-galls.

Gallait, Louis, loo-ē gä-lā, Belgian historical painter: b. Tournai, Belgium, 10 May 1810; d. Brussels 20 Nov. 1887. He studied in Tournai, Antwerp, and Paris, where he acquired a name by his portraits as well as his genre and historical paintings. Among his earlier pictures of note were: 'Christ Restoring Sight to a Blind Man'; 'The Strolling Musicians'; 'The Beggars'; 'Montaigne Visiting Tasso in Prison'; 'Abdication of Charles V.' Among his subsequent pictures are: 'Temptation of St. Anthony'; 'The Dead Bodies of Counts Egmont and Hoorn'; 'The Prisoner's Family'; 'The Last Moments of Count Egmont'; 'Alva Signing Death Warrants'; and lastly (1882), 'The Plague at Tournai,' purchased for Brussels Museum at the price of $24,000.

Galland, Antoine, äṅ-twän gä-lōṅ, French Orientalist and archæologist: b. Rollot, France, 4 April 1646; d. Paris 17 Feb. 1715. Attached in 1670 to the French embassy at Constantinople, he three years later accompanied the ambassador to Syria and the Levant. In 1676, and again in 1679, he made other visits to the East. In 1701 he was made a member of the Académie des Inscriptions, and in 1709 professor of Arabic in the Collège de France. The greatest part of his writings relate to archæological subjects, especially to the numismatics of the East; but the work which has secured him the greatest reputation is his translation of the 'Arabian Nights Entertainments' (1704–8), the first translation of these stories made into any language of Christendom. Among his other writings are: 'Remarkable Sayings, Witticisms, and Maxims of the Orientals' (1694), and 'The Indian Tales and Fables of Pilpay and Lokman' (1724).

Gallardo, Aurelio Luis, ō rēl yō loo-ēs' gäl-lär'dō, Mexican poet: b. León, Guanajuato, Mexico, 3 Nov. 1831; d. Napa, Cal., 27 Nov. 1869. He published three volumes of poems: 'Dreams and Visions' (Mexico 1856); 'Clouds and Stars' (Guadalajara 1865); and 'Legends and Romances' (1868); also a collection of poems, 'Home Stories.' He wrote many comedies. The drama, 'Maria Antonieta of Lorena' is regarded as his best work.

Gallas, gäl'läz, an Ethiopian race inhabiting Africa between lat. 9° and 3° S. and lon. 34° and 44° E. Their language is a descendant of the ancient Geez of Abyssinia. They are of average stature, with strong, well-made limbs, skin of a light chocolate brown, hair frizzled but not woolly. Though cruel in war they are frank and faithful to promises and obligations. They are distinguished for their energy, both physical and mental, especially the southern tribes, which pursue pastoral avocations, notably the breeding of horses, asses, sheep, cattle, and camels, and those which live by hunting, especially the elephant. These same tribes are mostly still heathens, though Mohammedanism is rapidly making way among them. The more northerly tribes who dwell about Harar profess a crass form of Christianity, derived from Abyssinia, and for the most part raise cotton, durra, sugar, and coffee. The total Galla population, who call themselves Argatta or Oromo, is estimated at about 3,000,000. Politically they are divided into a great number of separate tribes, which are frequently at war with one another. But their inveterate foes are the Somali, who have gradually driven back the Gallas from the shores of the Red Sea and the extremities of the Somali peninsula, regions which were occupied by them in the 16th century, just as on the other side the Abyssinians and Shoans have beaten them back. The country they now inhabit is a plateau northwest of the Indian Ocean, with a hilly, well-timbered surface.

Gal'latin, Albert, American financier: b. Geneva, Switzerland, 29 Jan. 1761; d. Astoria, N. Y., 12 Aug. 1849. He was graduated at the university there in 1779. In 1780 he went to the United States, and was for a time teacher of French in Harvard College. In 1786 he removed to Pennsylvania, became a member of the State legislature, and in 1793 was elected to the United States Senate, but was declared ineligible. From 1795 to 1801 he served in the House of Representatives, and from 1801 to 1813 was secretary of the treasury, in which

post he showed himself one of the first financiers of his day. He took an important part in the negotiations for peace with England in 1814, and signed the Treaty of Ghent. From 1815 to 1823 he was minister at Paris, and in 1826 was sent to London as ambassador extraordinary. On his return in 1827 he settled in New York, and devoted much of his time to literature, being chiefly occupied in historical and ethnological researches. He was one of the founders and the first president of the Ethnological Society of America; and from 1843 to his death was president of the New York Historical Society. His works include publications on finance, politics, and ethnology; among these last are: 'The Indian Tribes East of the Rocky Mountains, etc.' (1836), and 'Notes on the Semi-Civilized Nations of Mexico, Yucatan, and Central America' (1845). Consult Henry Adams, 'Life of Albert Gallatin' (1879).

Gallatin, Mo., city and county-seat of Daviess County, on the Wabash, and the Chicago, R. I. & P. R.R.'s, and on the Grand River, 55 miles northeast of St. Joseph. It is in a farming region and has lumber industries. Pop. (1900) 1,780.

Gallatin, Tenn., town and county-seat of Sumner County, on the Louisville & N., Chesapeake, and Nashville R.R.'s, 26 miles northeast of Nashville, and three miles from the Cumberland River. Its industrial and commercial activities are connected with stock-raising, agricultural products, lumbering, cotton, and woolen manufactures, flour milling, and foundry and machine products. Pop. (1900) 2,409.

Gallaudet, găl-â-dĕt', **Edward Miner,** American educator: b. Hartford, Conn., 5 Feb. 1837. He is a son of Thomas Hopkins Gallaudet (q.v.), and was graduated at Trinity College in 1856. He organized the Columbia Institute for the Deaf, Dumb, and Blind in Washington, D. C., in 1857, and from it developed the Gallaudet College for the Deaf, of which, in 1864, he became president. His publications include: 'Manual of International Law' (1879), and 'Life of Thomas Hopkins Gallaudet' (1888).

Gallaudet, Thomas, American Episcopal clergyman: b. Hartford, Conn., 3 June 1822. He was a son of Thomas Hopkins Gallaudet (q.v.); was graduated at Trinity College in 1842, and teacher in the New York Institution for Deaf-Mutes 1843–58. He was ordained in 1851; founded and became rector of St. Ann's Church, New York, for deaf-mutes, in 1852; was appointed general manager of the Protestant Episcopal Church Mission to Deaf-Mutes in 1872; and founded the Gallaudet Home for Deaf-Mutes, near Newburg, N. Y., in 1885.

Gallaudet, Thomas Hopkins, American educator: b. Philadelphia 10 Dec. 1787; d. Hartford, Conn., 9 Sept. 1851. In 1817 he founded at Hartford, Conn., the first deaf-mute institution in America, and was president of the same till 1830. In 1838 he became chaplain of the Insane Asylum at Middletown, Conn., where he remained till his death. He was the author of 'Bible Stories for the Young' (1838), and 'The Child's Book of the Soul,' etc. See Lives by Humphrey (1858), and E. M. Gallaudet (1888); Barnard, 'Tribute to Gallaudet.'

Galle, Johann Gottfried, yō'hän gŏt'frēd gäl'lĕ, German astronomer: b. in Pabsthaus, Prussia, 9 June 1812. He studied natural sciences and mathematics in Berlin 1830–3; discovered three comets in 1839–40; was the first to observe the planet Neptune (23 Sept. 1846); and in 1851 became director of the observatory in Breslau and professor of astronomy in Breslau University.

Gallegos, gäl-yā'gōs, Argentina, a river and city in the extreme southern part. The river rises in the Latorre Mountains and empties into the Atlantic Ocean; length 160 miles. The city is near the mouth of the river in Santa Cruz Territory and has a population of about 5,000.

Gallein, găl'e-ĭn, Pyrogallolphthaleïn. Formula, $C_{20}H_{10}O_7$. Obtained by heating for some hours one part of phthalic anhydride with two parts of pyrogallol from 190° to 200°, then dissolving the fused mass in alcohol, precipitating with water, and recrystallizing from dilute hot alcohol. It is used as a dye.

Gallenga, gäl-lĕn'gä, **Antonio Carlo Napoleon,** Italian publicist and author: b. Parma, Italy, 4 Nov. 1810; d. Llandogo, Wales, 17 Dec. 1895. He left Italy in 1831 by reason of political disturbances, and lived abroad. He represented Piedmont at Frankfort in 1848–9, and was a member of the Italian Parliament 1854–64. He was long the London *Times'* special correspondent in Italy. His works, many of them issued under the name of "L. Mariotti," include: 'Italy, Past and Present' (1841–9); 'Castellamonte, an Autobiography' (1854); 'Mariotti's Italian Grammar,' which went through 12 editions; 'History of Piedmont' (1855–6); 'The Pearl of the Antilles' (1873); and several books of travel.

Gal'leon, a name formerly given to a very large kind of vessel, with three masts and three or four decks, such as those used by the Spaniards in their commerce with South America, to transport the precious metals. They were large, clumsy, square-sterned vessels, having bulwarks three or four feet thick, all of which were so encumbered with tophamper, and so overweighted in proportion to their draft of water, that they could bear very little canvas, even with smooth seas and light winds.

Gallery, in architecture, a long, narrow room, the width of which is at least three times less than its length. Galleries are destined for dancing, music, dining on festival occasions and are generally decorated with pictures in oil or fresco. Galleries have sometimes been built merely to receive collections of pictures, or to give a painter an opportunity for fresco paintings; hence a large collection of pictures, even if contained in several adjoining rooms, is called a gallery. A celebrated gallery described by Cicero was established by Verres, the well-known spoiler of Sicily. In modern Europe the gallery founded by Cosmo II. in Florence long held the first place; but it has now been eclipsed by several European galleries. The art treasures of Florence now form two collections, that of Uffizi, and that of the Pitti Palace. The Galérie du Louvre in Paris is among the finest in the world, though in 1815 it was stripped of many works of art, reclaimed by the different nations from whom they had been plundered

Among the other renowned European galleries are those at Versailles and Dresden, the Royal Gallery at Madrid, the Belvedere Gallery at Vienna, the Hermitage at St. Petersburg, the gallery of Berlin, the National Gallery in London, the National Museum at Naples, the Vatican and Borghese collections at Rome, and those in Munich, Brussels, Venice, Antwerp, Milan.

The term gallery is also sometimes applied to what is more properly termed a corridor, or to a platform projecting from the walls of a building supported by piers, pillars, brackets, or consoles, and in churches, theatres, and similar buildings to the upper floors going around the building next the wall. In ship-building, a gallery is a balcony projecting from the stern or quarter of a ship of war, or of a large merchantman; in fortification, a covered walk across the ditch of a town; and in mining to a narrow passage from one part of the mine to another.

Galley, the ancient and mediæval ship of the Mediterranean. The Venetian galleys were about 160 feet long above, and 130 feet by the keel, 30 feet wide, and 20 feet length of stern-post. They were furnished with three masts, and 30 banks of oars, each bank containing two oars, and every oar being managed by six or seven slaves, who were usually chained to it. In the fore part, after the invention of cannon, they had three small batteries of cannon, namely, two 36-pounders, two 24-pounders, and two 2-pounders. They had also three 18-pounders on each quarter, and carried from 1,000 to 1,200 men.

The term galley, as applied to the ships of the ancient Greeks and Romans, refers especially to their war-ships, which were propelled chiefly by oars.

The Greek or Græco-Etruscan vases show many illustrations of biremes, that is, galleys with two banks, or longitudinal rows, of oars. The invention of this form of vessel was a very important advance in naval construction, for it permitted of a large increase in rowing-power, in proportion to the bulk and weight of the vessel. It was the trireme, however, which formed the chief war-ship of Greece during her prime. It had three banks of oars on each side. The seats for the rowers, which were removable, were placed between the sides of the vessel and a series of upright and inclined timbers supporting the main deck. The stem of the vessel was generally curved, and terminated in an ornamental figure-head, and the stern-post was also usually curved upward and finished off ornamentally. At the stern there was an elevated quarter-deck, whence the helmsman and the trierarch or naval captain gave their orders. The latter had full command of the ship; the former acted as navigating officer, having the oarsmen and sailors under his command. The trireme had regularly two masts — a mainmast with one large sail, and a very small foremast.

The rowers formed much the largest portion of the crew, while an Attic trireme carried also 10 marines, 17 sailors, a sort of paymaster, two men in charge of the lines of towers, besides two boatswains, one with a flute, to give the time to the rowers. The total crew would thus be about 220. The total length of a trireme was about 120 feet, of which about 100 was devoted to the rowers; the breadth at the water-line was some 12 feet; and the draught about 6 feet. A speed of 8 or 9 knots was probably about the highest obtainable.

The Romans did not become important as a maritime nation till the period of their struggle with Carthage. They built large numbers of ships, chiefly of higher rates than the trireme. But the triumph of the bireme vessels, known as Liburnian galleys, at Actium led the way for a reversion to lower-rated ships.

Galli, găl'ī, the emasculated priests of the Greek goddess Rhea, afterward identified with the Asiatic Cybele, and worshipped as symbolizing the procreative powers of nature. Cybele was the "Great Mother" and inspired the arts of agriculture. The true home of this cult was Pessinus in Galatia, but it never obtained public recognition in Greece, where the excesses and mendicity of its priests exposed it to contempt. It was introduced into Rome 204 B.C., at the bidding of the Sibylline oracle, and for the purpose of expelling Hannibal from Italy. The Galli were permitted to pass in a procession through the streets of the city, led by an Asiatic priest and priestess, but Roman citizens were forbidden to participate in this service. The cult gained an increasing favor and popularity and in the 2d century A.D. other rites were added, such as baptism in the blood of bulls and rams, by which the devotee was supposed to be cleansed from pollution and regenerated. This baptism was undergone by the Emperor Julian, called the Apostate. The worship of Cybele was checked by Constantine and abolished by Theodosius.

Gallic Acid, $HC_7H_5O_5,H_2O$, is an acid which exists in small quantity in gall-nuts, in valonia (the acorn-cup of *Quercus ægilops*), in dividivi (the pod of *Cæsalpinia coriaria*), in sumach, and other vegetables. It is usually prepared from gall-nuts, which, in addition to gallic acid, contain a large proportion of tannin (tannic acid or gallo-tannic acid). When the gall-nuts are digested with water for some weeks fermentation takes place, and the tannic acid is gradually converted into gallic acid. The same result is obtained more quickly if sulphuric acid be present. To obtain pure gallic acid the gall-nuts are boiled with water, and the hot liquor separated. On cooling gallic acid crystallizes out, and is further purified by solution in hot water and treatment with animal charcoal. It forms delicate, silky, acicular crystals, nearly colorless, and having a sourish taste. It is soluble in three parts of boiling water, but only in 100 of cold water, and on this account it can be readily purified by recrystallization. With solution of iron salts (ferric) it produces a blue-black color, and finally yields a black precipitate on exposure to the air. Hence it may be used in the production of ink, for which purpose it has some advantages over tannin or gall-nuts. When the crystals are strongly heated pyrogallic acid is produced and sublimes over. Gallic acid is a useful astringent. As it does not coagulate albumen it is readily absorbed into the blood, and in this way it is efficacious in Bright's disease. Where a decided local astringent effect is desired tannic acid is much more powerful.

In medicine gallic acid is used as an astringent. In most respects its action is similar to that of tannic acid (q.v.), but it does not coagulate albumen, and therefore does not pos-

sess the local action as an astringent. It has been used in excessive sweating, and is useful for sweating feet and as a local spray and gargle in tonsilitis, pharyngitis, and similar affections of the nose and throat.

Gallican Church. See GALLICANISM.

Gal'licanism, the tendency to enlarge the prerogatives of a national Church in restriction of the authority of the Roman See. This term more especially describes the manifestation of that spirit in the history of the Church in France, and takes its derivation from the controversies between the French monarchy at various times and the Roman pontiffs in regard to ecclesiastical jurisdiction. It is a mistake to suppose that Gallicanism took its rise in France prior to the 13th century, or that the decrees of Louis IX., including the Pragmatic Sanction, were in any proper sense an attempt to restrict the authority of the Roman pontiffs. So far from this being true, their object was to assure the immunities and franchises accorded to the clergy from the exactions of the royal officers and feudal lords. In his ordinance of April 1228, Louis IX., or rather his mother, Blanche of Castile, the regent, says not a word about the relations of the clergy or the laity with the Roman pontiff, and Pope Innocent IV., in 1250, in a letter to the queen, thanks her for issuing it.

It was not until the time of Philip the Fair that Gallicanism in any proper sense can be said to have manifested itself. That monarch in his contest with the papacy sowed the seeds of the long controversy as to the question of papal jurisdiction, which so long agitated the French Church. As a result of his contest with Boniface VIII., and of the later declarations of the Councils of Constance and Basel, the principles began to be enunciated by the national party; one that the king of France was absolutely independent of the pope in all temporal matters; the other, that the papal power was not absolute, must be exercised within the limits of the canons, and was inferior to that of a general council. By the Pragmatic Sanction passed at Bourges in 1438, the Gallican Church, in union with the king, adopted the decrees of the Council of Basel abolishing papal reservations and expectatives, and restricting appeals to Rome to the *causæ majores.* Against this many popes protested, but it was not until the date of the concordat (1516) between Leo X. and Francis I. that it was abolished.

During the 16th century there were many customs and privileges of more or less ancient date still extant, which the national party delighted to call "Gallican liberties." The crisis came in the 17th century, during the reign of Louis XIV., over the question of the royal right of regalia (q.v.). Two bishops excommunicated the crown nominees to benefices in their dioceses. Their Metropolitans canceled their sentences; whereupon they made appeal to Rome, and the pope annuled the decisions of the Metropolitans. The crown resented the pope's decision as an intrusion upon its rights. Louis XIV. called an assembly of French bishops (1682) to confirm his position. This assembly formulated the famous Four Articles setting forth the "Gallican liberties." The first declared that the jurisdiction of Peter's successor did not extend to civil and temporal affairs, that kings were subject to no ecclesiastical power in temporals, and denied the deposing power of the popes. The second ratifies the third and fourth sessions of the Councils of Constance as regards the respective authority of the pope and general councils, and denies that these sessions refer only to times of schism. The third asserts the validity of the laws, customs, and constitutions of the realm, and of the Gallican Church. The fourth declares that although the pope has the principal share in questions of faith, and that his decrees regard all and particular Churches, still his judgment is not irreformable, unless the consent of the Church be added.

Afterward, at the command of the king, who subsequently realized the radical character of the Four Articles, the bishops who had signed them individually wrote to the pope retracting their *Declaration.* Later Louis himself wrote to Innocent XII., in 1693, stating that he had "given the necessary orders to the effect that the contents of my edict of 22 March 1682, concerning the *Declaration* emitted by the clergy of France, be not observed."

Nevertheless, the spirit of Gallicanism lingered on in France, finding fresh impetus in Jansenism. During the 18th century its strength rapidly waned, and by the time of the French Revolution (1789) it had ceased to have any vital significance.

Gallienus, găl-ĭ-ē'nŭs, **Publius Licinius Valerianus,** Roman emperor: d. 268 A.D. He received the title of Cæsar from the senate at the same time with his father, Valerianus, and associated with the latter in the empire on his accession in 253 A.D. His father having been defeated and taken prisoner by Sapor, king of the Persians, in 260, Gallienus showed complete indifference, and continued to reign alone without making any attempt to deliver his father. With a like indifference he saw his empire dismembered by numerous usurpers, and invaded in all parts by barbarians.

Gallifet, Gaston Alexandre Auguste, gäs-tôṅ äl-ĕks-ändr ō-güst gä-lē-fā, MARQUIS DE, French general: b. Paris, France, 23 Jan. 1830. He joined the army in 1848, serving in the Crimea, Mexico, and Algeria. He took part with the Army of the Rhine during the Franco-German War, being made prisoner at Sedan. During the second siege of Paris he commanded a brigade of the Army of Versailles, and was unenviably distinguished for his frightful severity to the Communard prisoners. Promoted to the rank of general of division 3 May 1875, he obtained the command of the 1st division of cavalry, and in February 1879, that of the 9th regiment. He became minister of war in 1899.

Gallin, in chemistry, gallin, $C_{20}H_{14}O_7$, or $O[C_6H_2(OH)_2]_2.CH.C_6H_4.CO.OH$. Obtained by long boiling gallein and zinc-dust and ammonia, then acidifying with dilute H_2SO_4 and shaking out with ether. It crystallizes out of ether in fine needles, and quickly reddens in the air. It can be used as a dye instead of logwood.

Gallinger, Jacob H., American politician: b. Cornwall, Ont., 28 March 1837. He studied medicine, which he practised from 1858 until his entrance upon public life as a member of the New Hampshire legislature in 1872–3. He was in the State Senate in 1878–80, and its president

during the last two years. In 1885–9 he was a representative in the Federal Congress, and in 1891–1903 senator. From 1882 to 1890 he was chairman of the Republican State Committee.

Gallinule. See MUD-HEN.

Gallio, găl'ĭ-ō, **Lucius Junius,** Roman proconsul of Achaia under Claudius when St. Paul was at Corinth, 53 A.D. He was brother of the famous Seneca, and had procured his name by adoption into the family of Gallio the rhetorician. The narrative in the 'Acts of the Apostles' tells how, with regard to the clamor of the Jews against Paul, he was "not minded to be a judge of these matters"; and how "Gallio cared for none of these things"; hence his name has become a synonym for a careless, easy-going, and indifferent man who keeps himself free from trouble and responsibility.

Gallipoli, gäl-lēp'ō-lē, Turkey, a seaport on the peninsula of the same name, at the extremity of the Dardanelles, 130 miles west of Constantinople. The ancient Kallipolis, of which some ruins remain, it was formerly the most important commercial town on the Hellespont, and still retains considerable trade. There are two harbors, extensive bazaars, and some manufactures. The town was taken by the Turks in 1356, and formed their earliest European possession; and here the allies disembarked during the Crimean war. Pop. 20,000.

Gallipoli, Peninsula of, Turkey, a tongue of land separating the Hellespont from the Ægean Sea and the Gulf of Saros, 62 miles long, by a varying breadth of from 4 to 12 miles. Lat. between 40° 3′ and 40° 38′ N., lon. between 26° 10′ and 27° E.

Gallipoli Oil, a coarse olive oil used in Turkey-red dyeing and for other purposes, and prepared from olives grown in Calabria and Apulia, the latter being considered the best. The oil is conveyed in skins to Gallipoli, where it is clarified and shipped in casks.

Gallipolis, găl-ĭ-pō-lēs, Ohio, city and county-seat of Gallia County; on the Ohio River, and on the Columbus, H. V. & Toledo, and the Ohio C. R.R.'s. It contains a United States Marine Hospital, Gallia Academy, the State Hospital for epileptics, Washington High School, and a private epileptic sanitarium. Pop. (1900) 5,432.

Gallitzin, gäl-lēt'sĕn, the name of a noble Russian family whose members have been equally prominent in war and diplomacy from the 16th century downward. VASILI, surnamed the Great (b. 1643; d. 1714); was the councilor and favorite of Sophia, the sister of Peter the Great, and regent during his minority. His great aim was to bring Russia into contact with the west of Europe, and to encourage the arts and sciences in Russia. His design to marry Sophia and plant himself on the Russian throne miscarried. Sophia was placed by her brother in a convent and Vasili banished (1689) to a spot on the Frozen Ocean, where he died. AMALIE, PRINCESS GALLITZIN (1746–1806), daughter of the Prussian general, Count von Schmettau. She was noted for her literary culture, her sympathetic relations with scholars and poets, but, above all, for her ardent piety, which found in Catholicism its most congenial sphere. Having separated from her husband, Prince Dimitri Alexievitch, she took up her residence in Münster, where she gathered round her a circle of learned companions. PRINCE DIMITRI ALEXIEVITCH, diplomat (b. 1738; d. 1803). He was ambassador to the court of France in 1763, and to The Hague in 1773, and was the author of several works relating to geology.

Gallitzin, Dimitri Augustine, PRINCE, American clergyman: b. The Hague 22 Dec. 1770; d. Loretto, Pa., 6 May 1841. He was a son of Prince Dimitri Gallitzin (q.v.), and became a Roman Catholic in his 17th year. He was ordained a priest in the United States in 1795; and betook himself to a bleak region among the Alleghany Mountains in Pennsylvania, where he was known as "Father Smith." Here he laid the foundation of a town called Loretto. He declined to return to Russia on his father's death, and as a Catholic priest was adjudged to have lost his right of inheritance. He was for some years vicar-general of the diocese of Philadelphia. He was austere in his mode of life, but liberal in the highest degree to others, and an affectionate and indefatigable pastor. In 1809 he resumed his original name. He wrote various controversial works, including a 'Defense of Catholic Principles' (1816); 'Letter to a Protestant Friend' (1820), and 'Appeal to the Protestant Public' (1834).

Gal'lium, a metallic element, symbol Ga, atomic weight 69.9. Gallium is a triad element. Specific heat 0.079. It was discovered by the French chemist, Lecoq de Boisbaudran by means of the spectroscope; but the Russian chemist Mendeléeff had shown in his periodic law (q.v.) that an element must exist having intermediate properties between aluminum and indium. He called this supposed element eka-aluminum. The metal is obtained by dissolving the blende in sulphuric acid and placing in the solution plates of zinc. A precipitate containing gallium as a hydrated oxide is thus obtained, and after further solution and precipitation metallic gallium is thrown down by zinc. Gallium is a hard metal, very slightly malleable, and leaves a bluish-gray trace on paper; when melted it adheres to glass; it does not tarnish in the air. Its specific gravity is 5.95. It gives a brilliant violet line in the spectrum. When heated in the air it oxidizes on the surface, and does not volatilize. It dissolves in hydrochloric acid with disengagement of hydrogen. It is scarcely attacked by nitric acid in the cold; when heated it dissolves slowly with evolution of nitrous fumes. It forms salts.

Gallium Chloride, in chemistry, $GaCl_3$ It is colorless, crystalline, and deliquescent.

Gallium Salts, salts precipitated by ammonia. If redissolved by hydrochloric acid, and again precipitated by ammonia, the precipitate is soluble in excess. If zinc is present the gallium is precipitated along with the zinc. Potassium ferrocyanide gives a yellow precipitate with strongly acid solutions of gallium chloride.

Gallon. See WEIGHTS AND MEASURES.

Gallotannic Acid. See TANNIN.

Gal'loway, Beverly Thomas, American horticulturist: b. Millersburg, Mo., 16 Oct. 1863. He was graduated from the University of Missouri, agricultural course, in 1884; was assistant in the horticultural department of the university in 1884–86, and in the United States De-

partment of Agriculture, division of vegetable physiology and pathology, in 1887–8. In 1900 he became director of the office of plant industry. His writings include works on plant diseases, botany, horticulture, and allied subjects.

Galloway, Charles Betts, American bishop of the Methodist Episcopal Church, South: b. Kosciusko, Miss., 1 Sept. 1849. In 1868 he entered the Mississippi conference, and for several years he was pastor of various churches in that State. From 1882 until 1886 he was editor of the New Orleans 'Christian Advocate.' He was also elected president of the board of education of his Church, and published a 'Life of Bishop Linus Parker'; 'Hand-book of Prohibition'; 'Open Letters on Prohibition,' written during his controversy with Jefferson Davis on that subject; 'Modern Missions: Their Evidential Value'; and 'Christianity and the American Commonwealth.'

Galloway, Joseph, American lawyer: b. near West River, Md., about 1729; d. Hertfordshire, England, 29 Aug. 1803. He was admitted to the bar in Philadelphia, and was a member of the Pennsylvania Assembly 1757–74. He held a seat in the Congress of 1774, where he suggested a plan of government headed by a president-general to be appointed by the king and to hold office during the latter's pleasure, and a grand council elected every three years by the assemblies of the several colonies. Before the conclusion of the Revolutionary War he removed to England; and in 1788 was charged with high treason by the Assembly of Pennsylvania, which ordered his estates to be sold. He was the author of: 'A Candid Examination of the Mutual Claims of Great Britain and the Colonies: with a plan of accommodation on Constitutional Principles' (1780); 'History and Political Reflections on the American Rebellion' (1780); etc. Consult: Balch (ed.), 'Examination of Joseph Galloway by a Committee of the House of Commons' (1855); Tyler, 'Literary History of the American Revolution' (1897).

Galls and Gall-makers. Galls are unnatural plant-growths caused by various forms of insects, more particularly by the hymenopterous family of gall-flies (*Cynipidæ*). Gall-gnats (*Cecidomyiidæ*, — minute two-winged midges or flies), many species of mites, some forms of caterpillars, and the larvæ of weevils and other beetles also cause galls. The formation of a gall is due to the puncturing of any portion of a plant, the surface of the leaf, stem, roots, or bark and the deposition of an egg in the cavity formed, or by the presence of the larvæ subsequently hatched from it. Within these excrescences the larvæ feed and grow, and either eat their way out while still grubs or remain till the pupa stage is past and emerge as adolescent insects. A gall may contain a single egg and larva or many, and both external form and internal structure vary widely. Each gall-fly has its favorite or exclusive host, and usually restricts its egg-laying to some special part of the plant. While most produce true galls, some members of the family utilize galls already formed.

Fig. 1.— Bedeguar Gall of Wild Rose.

The reproductive relations of gall-flies are very interesting: in many cases parthenogenesis undoubtedly occurs; in some species, for example, of Rhodites, no males have ever been found; in other forms the males when they occur are very few in proportion to the females. It must be emphasized that many gall-wasps distinguished by entomologists as separate species or even referred to different genera have turned out to be the parthenogenetic and the sexual forms of one species. A common life-

Fig. 2.— *a*, oak gall produced by *Cynips quercus-folii*; *b*, section of gall; *c*, gall-insect (*Cynips quercus-folii*).

history is as follows: (*a*) Out of a summer-gall male and female forms emerge; (*b*) the females lay their fertilized eggs and give origin to winter-galls in so doing; (*c*) from these winter-galls there arise parthenogenetic females which in their egg-laying produce the summer-galls from which we started.

Galls vary greatly in shape, and may be solid or spongy, and contain one or several cavities, in each of which a larva is lodged. Though galls are very generally distributed, they occur in commerce chiefly as Levantine articles of trade. The Aleppo nut-galls are spherical and tubercular: blue, black, and white varieties are recognized, the two former being picked before the escape of the larva, the latter after its exit. They are produced by a gall-fly (*Cynips gallæ-tinctoriæ*) on twigs of an oak (*Quercus infectoria*). The galls made on oak by the common British "ash-fly" (*C. quercifolia*), or by the hundred or more American species of Cynips, might serve the purpose of ink making, tanning, etc., just as well; the 70 to 80 per cent of tannin they contain is the principal element of value. Dead Sea Apples, or Mecca or Bussorah galls, or Apples of Sodom (*mala insana*, or *C. q. infectoriæ insana*), are varieties of this vegetable product. The artichoke or strobile galls consist of several pieces, and resemble the fruit (strobilus) of the hop; it is due to the abnormal development of the female involucre before fecundation; its insect is the *C. q. gemmæ*. The hairy galls, or bedeguars, or rose sponges, are chiefly found on *Rosa rubiginosa*; they are produced by *Rhodites rosæ*.

Consult Howard, 'The Insect Book' (New York, 1901), and accompanying bibliography.

Gallus, Caius Cornelius, Roman poet: b. Forum Julii (modern Fréjus), Gaul, about 66 B.C.; d. 26 B.C. He lived at Rome in intimate friendship with Vergil, Asinius Pollio, Varus, and Ovid, and was appointed by Augustus prefect of Egypt, but fell into disfavor and was banished, whereupon he ended his disgrace with his own sword. Gallus was reckoned the founder of the Roman elegy, from his four books of elegies on his mistress Lycoris, of which but a few slight fragments have come down to us. His name was adopted by W. A. Becker as the title of his well-known picture of Roman domestic life: 'Gallus: Roman Scenes from the Time of Augustus' (1838).

Gally, Merritt, American inventor: b. near Rochester, N. Y., 15 Aug. 1838. He was graduated at the University of Rochester in 1863; and later turned his attention to mechanics. His inventions include the "Universal" printing-press; a machine for making linotypes; electric, telegraphic, and philosophical apparatus; musical instruments, including the "Orchestrone," the "Black-Vent System" for tubular church organs; the "Counterpoise Pneumatic System" of the automatic musical instruments, etc.

Galois, Evariste, French mathematician: b. Bourg-la-Reine 1811; d. Paris 1832. He obtained his early education in the Collège de Louis-le-Grand and entered the Ecole Normale in 1830, while there writing a theorem on the solubility of irreducible equations of prime degree by radicals, six articles on the theory of equations and theory of numbers, and with others founded the theories of groups and functions. His works were published in Paris (1897). See EQUATIONS, GALOIS THEORY OF.

Galoparo, gäl-ō-pä'rō, or **Capo di Faro**, kä'pō dē fä'rō, the Charybdis of the ancients. It forms the whirlpool on the outside of the harbor of Messina, in the strait separating Italy from Sicily. Opposite, on the Italian coast, is the rock Scylla.

Galt, gâlt, SIR **Alexander Tilloch**, Canadian statesman: b. London, England, 6 Sept. 1817; d. Montreal 19 Sept. 1893. He was a son of John Galt (q.v.) and went to Canada while still a boy. He made a fortune in the service of the British and American Land Company; was Canadian minister of finance in 1858–62, 1864–6, and in 1867; and Canadian high commissioner to England in 1880–3. He published 'Canada from 1849 to 1859.'

Galt, John, Scottish novelist: b. Irvine, Ayrshire, 2 May 1779; d. Greenock, Scotland, 11 April 1839. In 1804 he went to London, and entered into a mercantile partnership, but the venture soon ended in bankruptcy. He then resolved to try the legal profession, and entered himself at Lincoln's Inn, but made small progress in his studies, and quitted England in 1809. He made a tour of the south of Europe and the Levant, and on his return in 1812 published 'Voyages and Travels in the Years 1809, 1810, and 1811,' and 'Letters from the Levant.' The same year appeared his 'Life of Cardinal Wolsey,' and also a volume of tragedies, which received a rough handling from the 'Quarterly Review.' Among his other literary labors of this period was the tragedy of 'The Witness,' a life of West the painter, and a romance on the legend of the 'Wandering Jew.' In 1820 and 1821 the 'Ayrshire Legatees,' a series of letters descriptive of a supposed visit by a Scottish minister's family to London, appeared in 'Blackwood's Magazine,' and attracted universal attention. Its success induced him to publish immediately afterward his 'Annals of the Parish,' which was received with no less approbation. 'The Provost,' 'The Steamboat,' 'Sir Andrew Wyllie,' and 'The Entail' appeared in rapid succession. These were all extremely popular, but his subsequent novels, 'Ringan Gilhaize,' 'The Spaewife,' and 'Rothelan,' did not sustain the reputation which he had acquired. From 1826–29 he was superintendent to the Canada Company. While in Canada he founded the town of Guelph. He wrote the novel of the 'Last of the Lairds.' After his return to England he set himself resolutely to work, however, at his literary tasks, and produced successively 'Laurie Todd'; 'Southennan'; 'Life of Lord Byron'; 'Autobiography of John Galt'; 'Literary Life and Miscellanies of John Galt,' in three volumes.

Galt, SIR **Thomas,** Canadian jurist: b. London, England, 17 Aug. 1815. He went to Canada 1832 in the employ of the Canadian Land Company, was admitted to the bar 1845 and practised in Toronto. He became Queen's Counsel 1858, Chief Justice of the Court of Common Pleas 1887, retiring in 1894. He was knighted in 1888.

Galt, Canada, town of Waterloo County, Ontario, on the Grand River, the Canadian P. and the Grand T. Rys., 25 miles northwest of Hamilton; named for John Galt (q.v.). The town is picturesquely situated on both sides of the river which is here crossed by several bridges. It is substantially built and lighted by gas and electricity; an important jobbing centre; the seat of a United States consular agent; and has manufactories of flour, axes, paper, woolens, leather, foundry products, wooden-ware, and paper. It has several churches, good schools, a collegiate institute, a public library and reading-room, banks, and daily and weekly newspapers. Pop. (1901) 7,866.

Galton, gâl'tọn, **Francis,** English scientist: b. Duddeston, England, 1822. He was educated at King Edward's School, Birmingham; studied medicine at the Birmingham Hospital and King's College, London; and graduated from Trinity College, Cambridge, in 1844. Having in 1846 traveled in North Africa, he explored in 1850 lands hitherto unknown in South Africa, publishing his experiences in his 'Narrative of an Explorer in Tropical South Africa' (1853), which obtained the gold medal of the Royal Geographical Society, and in 'Art of Travel' (1855). His investigations in meteorology are recorded in 'Meteorographica' (1863). A member of a Meteorological Committee of the Board of Trade, he was appointed one of the committee entrusted with the parliamentary grant for the Meteorological Office. Later he specially devoted himself to the problem of heredity, publishing: 'Hereditary Genius: its Laws and Consequences' (1869); 'Experiments in Pangenesis' (1871); 'English Men of Science: their Nature and Nurture' (1874); 'Life-History Album' (1884); 'Natural Inheritance' (1889); 'Finger Prints' (1893); 'Fingerprint Directory' (1895), etc. He was general secretary of the British Association in 1863–8; president of the An-

thropological Section in 1877 and 1885; and president of the Anthropological Institute in 1885–6.

Galuppi, Baldassare, bäl-däs-sä-rā gä-loo'pē, Italian composer: b. island of Burano, near Venice, 18 Oct. 1706; d. Venice 3 Jan. 1785. He was sometimes called "Il Buranello." From 1722 he was an organist in Venetian churches, and he early wrote an opera, 'Gli amici rivali.' After study of advanced composition as a pupil of Lotti, he again turned to writing, and achieved notable success with more than 70 comic operas, among them: 'Il mondo della luna,' and 'Il mondo alla rovescia.' He has generally been considered the originator of comic opera (opera buffa) in Italy. From 1741 he was for some time resident and active in London, in 1762 became maestro di capella at St. Mark's and director of the Conservatorie degli Incurabili, and in 1765–8 was in Russia as court composer and director of music. He wrote also some sacred works, but none of his compositions is known to-day save a harpsichord sonata which finds place in Pauer's 'Alte Klaviermusik.' He is apostrophized by Browning in 'A Toccata of Galuppi's.'

Galva, Ill., town in Henry County, on the Chicago, B. & Q. and the Rock I. & P. R.R.'s; 45 miles southeast of Rock Island and 48 miles north-northwest of Peoria. It is in a rich agricultural and coal region, on one of the highest points of the dividing ridge between the Mississippi and Illinois river-basins, and besides coal-mining, has considerable manufacturing interests. It has two banks and two weekly newspapers. Pop. (1900) 2,682.

Galvani, Luigi, loo-ē'jē gäl-vä'nē, Italian physiologist; the discoverer of galvanism: b. Bologna 9 Sept. 1737; d. there 4 Dec. 1798. He studied medicine, and in 1762 entered on the practice of his profession. His favorite studies were anatomy and physiology. He soon received the appointment of professor of anatomy in the celebrated institute of his native city, and published a treatise on the urinary vessels of birds. While engaged in these pursuits he was fortuitously led to the discovery which has immortalized his name. His wife, the daughter of Galeazzi, a medical professor under whom he had studied, and a woman of superior intelligence, having observed that the contact of the inanimate body of a skinned frog with a scalpel lying on the table produced in the frog a series of remarkable muscular convulsions, the knife being in contact with an electric machine, informed her husband of the fact, who instituted a series of experiments, and formed conclusions which led to a controversy with Volta. On a journey to Sinigaglia and Rimini he was so fortunate as to trace the cause of the electric appearances which are observed in the torpedo, and wrote a learned treatise on this subject. The loss of his beloved wife in 1790 rendered him inconsolable. Having refused to take the oaths to the Cis-Alpine Republic, he was deprived of his chair, and refused to resume it, when the government, in consideration of his celebrity, offered to allow him to do so unconditionally. In Rome a medal was struck with his effigy.

Galvanic Batteries. See PRIMARY BATTERIES.

Galvanism. See ELECTRICITY; GALVANIZATION, TREATMENT OF DISEASE BY.

Galvaniza'tion, Treatment of Disease by. Of the different forms of electricity used in medicine the galvanic current is perhaps the most widely employed. It may be administered either locally or centrally; local galvanization is used especially for the relief of pain. It is applied to the brain, eye, ear, sympathetic nervous system, spinal cord, urethra, bladder, and chest, either by what is known as "stabile" application, in which both electrodes are kept in a fixed position, or by "labile" application, in which one or both electrodes are slid over the surface, but not lifted from the skin. It is found that a greater sedative influence is obtained if the galvanic current is not interrupted. Labile and stabile interrupted currents are generally preferred for the galvanization of muscles of the head, spinal cord and nerve-tracts. Stabile continuous currents, either uniform or increasing, give the best results. When the galvanic current is interrupted it causes, as is well known, pronounced muscular contraction. This is of service as a tonic to poorly nourished and atrophied muscles.

By "central" galvanization is meant that mode of treatment by the galvanic current by which the entire central nervous system may be brought under the influence of the electrical fluid. In order to accomplish this, one electrode, usually the negative, is placed over the solar plexus, at the pit of the stomach, while the other is firmly pressed to the top of the head and passed gradually over the back of the head and along the inner border of the strong muscle that pulls the neck to one side, the sternoclidomastoid. From here the electrode is passed down the spine. It is thought to increase the electrical excitability of the central nervous system, inducing sleep and relieving general tire. It is a method, however, that should be used with great caution, as it may do more harm than good. See ELECTRICITY, MEDICAL USES OF.

Galvanized Iron, sheets of iron coated with tin by a galvanic process, and with a second metal, zinc, which is effected by preparing a bath of fluid zinc covered with sal ammoniac mixed with earthy matter. When the tin-coated sheet is plunged into this preparation the zinc is precipitated with a crystal-like diaper upon the tin. The term is sometimes improperly applied to sheets of iron which have been coated with zinc without recourse to the use of galvanism. The iron, after being thoroughly cleaned from all trace of oxydization, by a dilution of sulphuric acid, is then plunged into a bath of melted zinc and other substances such as sal ammoniac, or mercury and potassium.

Galvanocau'tery, the use of a cautery knife, loop, point, or blade heated by the passage of a galvanic current. It is of value wherever a limited cautery action is desired, and particularly valuable in being easy to control.

Galvanometer, an instrument for measuring the intensity, direction or length of duration of an electric current. The many types of indicating instruments such as voltmeters and ammeters, where the pointer is held at zero by some directive force, such as the earth's field, a spring or weight or a permanent magnet, come under this head. With very few ex-

ceptions, all galvanometers may be classed under two heads: (1) Those having a magnetized needle suspended so as to move freely in a horizontal plane, the needle being normally held at zero position by means of the earth's field or an external field produced by auxiliary magnets placed to accomplish this result. The needle is suspended on a pivot or a quartz fibre or fibre of silk or other appropriate material. (2) Those having a coil of wire in place of the needle in the first class. This is the type usually called the d'Arsonnal type, and has the coil suspended by means of a fine wire, which provides a way for leading current to the coil, and has another wire underneath the coil for conducting the current from it. The coil, with the conducting wires, is then suspended between the poles of a magnet, its axis being normally at right angles with the lines of the field. The second class of galvanometers, those having a moving coil, are to be preferred for most classes of work, all except those requiring the very greatest delicacy, for the following reasons: The readings are but very slightly affected by the presence of an external field or by magnetic substances in vicinity of the instrument, and are practically independent of the variable influence of the earth's field; this form of instrument may easily be made dead-beat, on account of the strong field in which the coil moves; many forms are portable, and much less affected by vibrations than those of the first class.

The figure of merit of a galvanometer may be expressed either as the current necessary to cause a deflection of one scale division, or as the resistance through which one volt will cause a deflection of one scale division when such resistance is inserted in the circuit. Such an expression of the delicacy of a galvanometer should be accompanied with the following data: The resistance of the instrument, the scale distance and size of one division of the scale. The sensitiveness of a galvanometer is expressed as the difference of potential across the galvanometer terminals necessary to cause a deflection of one scale division; and to be exact, should be accompanied with the same data as for the figure of merit. Of the moving needle class of galvanometers the tangent galvanometer and the Thomson astatic galvanometers are probably in most general use. The tangent galvanometer is constructed so that the inside diameter of the coil which surrounds the needle is at least 12 times the length of the needle. Under these conditions, the needle being held at zero by the earth's field, the current strength will vary directly as the tangents of the angle of deflection; hence the name of the instrument. Although at one time much used for the absolute determination of current strengths, it has of late been replaced by other types, on account of its many correction factors, some of which are of uncertain magnitude, a prolific cause of error being the necessity of knowing the exact value of the horizontal component of the earth's magnetism, which quantity is subject to continual change and is affected by large masses of iron or heavy electric currents in the vicinity.

The Thomson Galvanometer.— This type was designed by Lord Kelvin, and to him we are indebted for the most sensitive instruments as yet made. The moving system consists of a slender quartz rod to the centre of which is fastened a small mirror of glass. Above and below the mirror at each end of the quartz rod is fastened a complex of carefully selected magnetized needles, minute in size, placed parallel to the plane of the mirror. In the upper complex the north poles of the needles are all placed in one direction, and in the lower complex the north poles of the needles are placed in the opposite direction, the combination forming an astatic system, on which the earth's field exerts a very slight directive force. This directive force exerted by the earth's field would be zero if the two complexes could be made exactly equal in magnetic strength. Each complex of needles is enclosed by two coils, thus making four coils in an instrument. These coils are provided with binding posts for series or parallel connection, and are connected so that the current flowing through them will cause the magnetized needles to be deflected in the same direction in each complex. An adjustable magnet mounted on top of the instrument provides a directive action on the needles which may be modified to any extent, a weak directive force increasing the sensitiveness greatly, and also increases the period of oscillation, so that in the best instruments the sensitiveness is limited largely to the patience of the observer.

Moving Coil Galvanometers.— This type is most familiar in the d'Arsonnal galvanometers, and is to be preferred for most purposes within the limits of its sensitiveness. Its preference lies in the fact that it may easily be made dead-beat, and the readings are practically independent of the earth's field or magnetic substances in its vicinity. The construction also adapts itself to a portable type of instrument, and it may be so constructed as to be very slightly affected by vibrations. The sensitiveness of this class of galvanometers may be further increased by substituting an electro-magnetic field for that produced by permanent magnets. Consult: Nichols, 'The Galvanometer.'

J. E. Taylor,
Western Electric Company, Philadelphia.

Galveston, Texas, city, port of entry and county-seat of Galveston County, on Galveston Island, at the mouth of Galveston Bay. It is on the Southern Pacific, the Missouri, K. & T., the Gulf, C., & S. Fe, the International and Grtat Northern, the Galveston, Houston & Henderson, and the Gulf & Interstate Railroads. The city, which includes Pelican Island, has a total area of 13 square miles.

Trade and Commerce.— Galveston is the natural entry port for the great Southwest. The trade year beginning 1 September, showed for the year of 1902–03 the breaking of many records. Comparative figures are as follows: Cotton receipts (1902–03) 2,093,070 bales; (1901–02) 2,090,710 bales. Bank clearings $413,185,000, an increase of $40,946,200. Galveston has advanced from fourth to third place in its rank among exporting ports of the United States. The total value of foreign exports and imports for the trade year (1902–03) was $105,632,087; (1901–02) $97,691,312. Total value of goods handled over the Galveston wharves (1902–03), $447,910,707; (1901–02) $246,567,246. Cash receipts at the custom-house from all sources (1902–03), $448,519; (1901–02) $220,321. The

total value of foreign exports (1902–03) \$104,121,087; (1901–02), \$96,181,423. The foreign imports for 1902–03, were \$1,511,334; (1901–02), \$1,192,758. The total value of foreign goods imported over the Galveston wharves during 1902 was \$3,233,039. A statement of the total tonnage entered or cleared at the port for 1902 shows 1,340 vessels with a tonnage of 3,094,903, compared with a total of 1,042 vessels, with a tonnage of 2,222,928 for 1901. The coastwise trade during the year 1902–03 more than doubled that of the previous year. Galveston has 53 lines of steamships to foreign ports. There are two regular lines of coastwise vessels to New York and 9 lines of coastwise vessels to points in the gulf. During 1902–03 over 90,591 loaded cars were handled in the yards of the Galveston wharf company by the various railroads, compared with a total of 77,139 loaded cars handled during 1901–02. The domestic exports are cotton, wool, hides, oil cake and oil meal, cottonseed oil, fish oil, cement, and poultry. The domestic imports are drugs, boots and shoes, hats, dry goods, chemicals and like commodities. The foreign exports are cotton, cottonseed oil, oil cake and meal, wheat, corn, flour, copper and iron ores, cattle, lumber and timber, and provisions. The foreign imports include fire brick, tiles, chemicals, cement, liquors, earthenware, prepared vegetables, and fancy woods. There are four export grain elevators, with a storage capacity of 4,000,000 bushels and one clearing and conditioning elevator. There are six miles of completed wharfage covered with sheds and a complete railroad trackage system which covers about 50 miles.

Public Buildings.—Galveston has 31 churches for white people and 12 churches for colored people, two orphan asylums, a home for homeless children and a home for aged women; the School of Medicine of the State University, 12 private or sectarian schools, a Roman Catholic university, two Roman Catholic academies, a business college and public high school and five graded schools for white children. One high and two graded schools for colored children; a library building which cost \$150,000 endowed with a fund of \$400,000; a Masonic temple and a Scottish rite cathedral.

Finances and Industries.— The city has eight private and two national banks, 21 building, loan, abstract and real estate corporations. The waterworks, fire department, sewer system and street electric-light plants are owned by the city. The waterworks plant is valued at \$1,550,000. The supply of water comes from artesian wells on the mainland and is piped under the bay. Two daily papers and eight weekly papers are published here. The city has two thoroughly equipped hospitals; 12 hotels; a large jobbing trade; bagging mills, rope mills, brewery, cement and pipe works, ice plants, iron works, sash, door and blind manufactories, cotton presses, clothing, cotton oil, flour, meal, coffee, baking powder, spices, extracts, pickles, preserves, macaroni and mineral water manufactories, and rice-mills.

Here is the recognized finest beach in the world, 30 miles long, sea-bathing, fishing, boating, driving and riding facilities unsurpassed and semi-tropical winters and balmy summer breezes offer a delightful climate the year round. Annual average temperature 69 degrees. Average temperature for July 84 degrees. Average temperature for January 53 degrees. Average annual rainfall 46 inches. The rate of taxation for the city is \$1.70 on the \$100 and for the State and county \$1.44⅔. Total tax rate \$3.14⅔ on the \$100. The assessments of the city for 1903 were \$20,574,000 and for the county \$21,895,950.

Government.— The State legislature in 1901 placed the city under a commission. This government has proved most satisfactory and is being run on a basis of about \$100,000 a year cheaper than the previous municipal administration. The State legislature also provided for the refunding of the bonded floating indebtedness of the county and for grade raising bonds. Authority was also granted to issue bonds on the approval of two thirds of the tax-paying citizens for breakwater purposes. The city commission appointed a board of engineers and plans for protection calling for an expenditure of \$3,505,000 were adopted. The bonds were voted almost unanimously and more than \$1,000,000 of the \$1,500,000 voted for breakwater purposes were subscribed for by Galveston people. The State legislature granted Galveston for a period of 17 years the State's portion of taxes on city property. This amounts to about \$80,000 per year. The money thus derived is to be used for the purpose of raising the grade of the city.

The Sea Wall.— Work on the Galveston sea wall was begun in October, 1902. Half the work on the structure was completed in September 1903. The wall will be 17,593 feet long, 16 feet wide at the base and 17 feet high. (See Galveston Sea-Wall.)

History.—About the year 1782 a Spanish fleet made an examination of the coast of the Gulf of Mexico west of the Mississippi River, and named Galveston Bay and island in honor of Conde de Galvez, then governor of Louisiana. The explorers found on the island one white man who subsisted by hunting and fishing. Galvez was governor of Louisiana from 1780 to 1785. Until the year 1816 Galveston island remained in its primeval state, a low island formed in process of time by the sea throwing up sand and shells. The conjecture that La Salle visited Galveston island during his brief stay in Texas is without reasonable foundation. The island was long a favorite hunting ground for the Caroñkawas, the once powerful and warlike tribe which inhabited so much of the coast of Texas. Francisco Zavier Mina, a young Spanish soldier, resolved to lend the patriotic cause in Mexico his sword and aid the people of that country in their struggle for liberty. He determined to make Galveston island his base of operations. He worked in co-operation with Don Luis Aury, a naval officer. His plan was approved by Herrara, commissioner of the Mexican revolutionary or Morelos government to the United States. Herrera, with Aury, landed on Galveston island with an expedition in September 1816. A government was organized, Aury was made civil and military governor of Texas and Galveston island and took the oath of fealty to the Republic of Mexico. In November 1816, Mina arrived at Galveston with a few small vessels and about 200 men. Mina and Aury abandoned the island in March 1817. Just about the time they left Galveston island we have the first account of Lafitte coming to the

island. The pirate is supposed to have reached Galveston late in 1816. He held letters of marque from the revolutionary government of Venezuela authorizing him to prey upon the commerce of Spain. He had a number of vessels and quite a force of adventurers. He also assumed to be governor of Texas under the revolutionary government of Mexico, probably having received some such authority from Herrera, the Mexican commissioner in New Orleans. Lafitte's purpose was to capture Spanish vessels sailing under the flag of the Mexican republic. By the close of the year 1817 the population of Galveston had increased to nearly 1,000. The United States and Spain found cause for complaint against the pirates, but Spain feared the United States would claim the island if the pirates were dispersed by the American naval establishment, and the United States did not feel called upon to take action, owing to the attitude assumed by Spain, consequently Lafitte was left undisturbed. In 1820 an American vessel was taken by Lafitte's men. The United States government then dispatched an armed vessel under Lieut. Kearney to break up the establishment at Galveston. Lafitte left Galveston for good, but continued his depredations upon Spanish shipping until 1826. In 1820 Dr. James Long visited Galveston island to induce Lafitte, who was about leaving Galveston, to co-operate with him in the establishment of a government at Nacogdoches. Lafitte referred to the failure of all previous attempts to invade Texas and refused to join Long. Before Long left Bolivar Point a French sloop freighted with wine stranded on Galveston island. Caroñkawas to the number of 200 were encamped in the vicinity. They attacked and butchered the crew, plundered the sloop and engaged in a drunken jollification. Long determined to chastise them. After nightfall with 30 men he passed over to the island in small boats. In the fight the Caroñkawas outnumbered the whites seven to one. Long was compelled to retreat. Three of his men were killed; 32 Indians were left dead on the field.

Little is heard of Galveston island after Long's expedition until just previous to the battle of San Jacinto. The island was practically abandoned from 1820 until along in the thirties, when the Mexican government established a custom-house on the island. On the occasion of the preliminary meeting at Brazoria to declare the independence of Texas in 1835 there was no representative present from Galveston. The same is true of the more formal declaration of independence which was made on 2 March 1836, at Washington on the Brazos. Just prior to the battle of San Jacinto the new Texas government retreated from Washington to Harrisburg. As Santa Anna and his army approached Harrisburg, President Burnet and his cabinet sailed down to Galveston island, narrowly escaping capture. The news of the victory at San Jacinto reached President Burnet on Galveston island 26 April 1836. The provisional government of Texas under Governor Smith in 1835 had granted letters of marque and reprisal and had provided for the establishment of a small navy. The Liberty, one of the vessels of this navy, was at Galveston at the time of the battle of San Jacinto. Several prizes were taken by the Texas navy and brought into Galveston Bay. During the hostile period following the battle of San Jacinto the Mexican government proclaimed a blockade against the ports of Texas and in attempting to enforce it interfered with vessels of the United States. In 1837 the Texas navy was increased and several vessels were stationed at Galveston. The third congress of the Texas republic assembled at Houston in November, 1838. The County of Galveston was represented for the first time in the third house of representatives by Moseley Baker. After the annexation of Texas and the outbreak of the Mexican War the first Texas regiment to join General Taylor was composed of six months' men raised and organized in Galveston, commanded by Albert Sydney Johnston. Galveston County was created 15 May 1838. The battle of Galveston during the Civil War, occurred 1 January 1863. The first railroad begun in Texas was at Harrisburg in 1852. The Galveston, Houston and Henderson road was begun at Virginia Point in 1855. Trains were first run from Virginia Point to Houston in 1859 and in that year a contract was let for the first Galveston bay bridge, which was completed and trains were run into Galveston in 1860.

The jetties at Galveston were completed in 1896, since which time the water at the point where the bar existed has been slowly deepening. (See GALVESTON, JETTIES AT.) Galveston wharves are only one hour from the deep sea for a laden steamer. Galveston wharf and terminal facilities, as a system, have few equals in the country, being excelled in no particular except size.

In December, 1836, Colonel Michael B. Menard purchased of the Republic of Texas for the sum of $50,000 one league and labor of land on the east end of Galveston island. He associated with him a number of persons and they formed a joint stock company known as the Galveston City Company, which was incorporated in 1841. This company is still in existence, although its present holdings of real estate are not large. The city of Galveston was incorporated in 1839. The first mayor was John M. Allen.

Galveston has had three noted philanthropists. George Ball gave the city the Ball High School, which cost $100,000 and has been added to since his death by his widow and son. He also left $50,000, the interest of which is to be used for the poor and deserving of the city. John Sealy presented the city with the Sealy hospital, which has cost over $100,000. Henry Rosenberg left $30,000 for an orphans' home, $30,000 for Grace church, $30,000 for a home for aged women, $65,000 for a Y. M. C. A. building, $50,000 for a monument to the heroes of the Texas revolution of 1836, $30,000 for drinking fountains, $150,000 for a library and $400,000 with which to endow the same. He also presented the city before his death with a $100,000 school building, which is known as the Rosenberg school.

The property loss at Galveston occasioned by the storm of 8 Sept. 1900, was $17,058,275. The loss of life on the island is estimated at 6,000. The total cash receipts of donations made to flood sufferers amounted to $1,243,495.

Population.— (1880) 22,248; (1890) 29,084; (1900) 37,789. The population of Galveston,

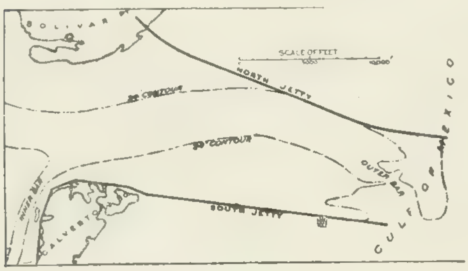
according to the City Directory for 1903-04 is 32,745.

R. G. Lowe,
Vice-President of the Galveston News.

Galveston Bay, an inlet of the Gulf of Mexico, extending northward from Galveston about 35 miles.

Galveston Island, an island off the coast of Texas on the northeastern end of which is Galveston. Length, about 28 miles.

Galveston, Texas, Jetties at. The entrance to Galveston harbor was originally obstructed by an inner bar upon which the depth of water was 9½ feet and an outer bar with a depth of 12 feet. The Federal government adopted the jetty system for improving the entrance to this harbor. Two jetties have been constructed of sandstone riprap and are covered with granite blocks weighing from 5 to 12 tons each. The south jetty is 35,603 feet in length and the north jetty 25,907 feet in length. They are to be built to a height of 5 feet above mean low tide and are from 12 to 15 feet in width at the top with a slope of about 1½ feet to each vertical foot in depth. The distance between the shore ends



of the jetties is about two miles, they converge until their sea ends are about 7,000 feet apart. There had been expended to 30 June 1902 on this work $8,519,684.42. The jetties, by confining the water, has increased the tidal scour and secured a depth of over 26 feet at mean low tide on both bars. These works were damaged by the hurricane of 8 Sept. 1900, but have been repaired with granite blocks of ten tons weight. There is every assurance of securing, when this work is completed, not less than 30 feet of water at mean low tide.

Walter Gresham.

Galveston, Military and Naval Operations at. In the summer of 1862 Farragut sent several light squadrons to cruise along the coast of Texas, and a blockade was maintained against Galveston, which was abandoned by the Confederate military forces, and 8 October surrendered by its civil authorities to Commander Renshaw of the United States Navy. Six United States vessels lay in the bay, commanding the city. 7 November Lieut. Jouen, with two launches, captured and burned the privateer Royal Yacht, carrying one heavy gun, and took 13 prisoners, with a Union loss of two killed and seven wounded. On 24 December, 260 men of the 42d Massachusetts regiment were landed and encamped on the city wharf. At daybreak, 1 Jan. 1863, Gen. Magruder, the Confederate commander in that department, made a combined naval and land attack upon the Union fleet in the bay and the military in the city. He secured four steamers from the adjacent rivers, used cotton-bales for armor, mounted them with guns and filled them with sharpshooters, and attacked the six United States vessels. The Westfield was blown up and destroyed by her officers to prevent capture; the Harriet Lane was boarded, and surrendered after her captain and executive officer had been killed. One of Magruder's boats went to the bottom in its encounter with the Harriet Lane. The land force was attacked by a largely superior force and, after a stout resistance, in which it had 20 men killed and wounded, surrendered. Magruder reported his loss as 26 killed and 117 wounded. The other United States vessels then abandoned the blockade, but Farragut quickly restored it, soon after which, 11 January, a strange vessel was seen outside and the Hatteras was sent to overhaul her. She proved to be the noted Alabama, and after a short and hot fight she sunk the Hatteras, saving her crew. Ten days later the Union gunboats Velocity and Morning Light, blockading Sabine Pass, were attacked by Confederate steamers, driven out to sea, and captured, with guns, prisoners, and a large amount of stores. Galveston remained in Confederate possession until the close of the war. Consult: 'Official Records,' Vol. XV.; Mahan, 'The Gulf and Inland Waters'; Maclay, 'History of the Navy,' Vol. II.; Lossing, 'Field Book of the Civil War,' Vol. II.; the Century Company's 'Battles and Leaders of the Civil War,' Vol. III.

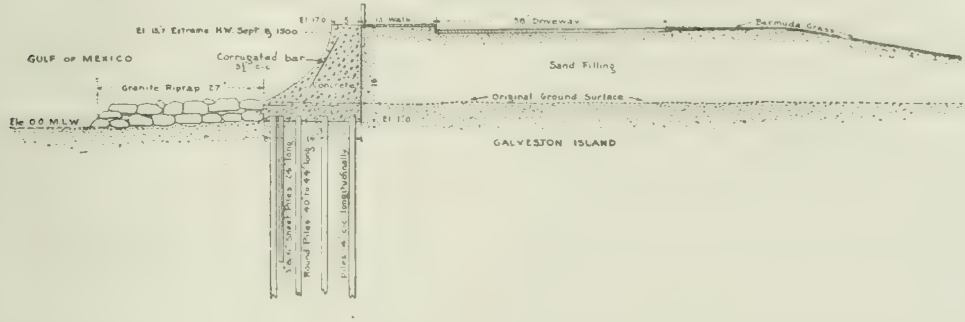
E. A. Carman.

Galveston Sea-wall. The date 8 Sept. 1900, in Galveston, Texas, will be referred to by its inhabitants for generations to come. The appalling loss of life and the destruction of property on that date, due to the terrific West Indian hurricane which drove the waters of the Gulf of Mexico over the oleander city, shocked the civilized world. Over 6,000 lives were sacrificed to satisfy the storm king's anger, and over $17,000,000 worth of property was completely destroyed. The city of Galveston is located on the east end of an island about 30 miles in length and from one to three miles in width. The entire south side of the island fronts on the Gulf of Mexico, while the north side fronts on Galveston Bay. As to the frequency of hurricanes, and the probability of Galveston being visited again, is a matter of mere conjecture. This city was settled in 1847, and since that time has been visited by six storms, none of which, however, caused the loss of exceeding three lives. In September 1875 a hurricane swept over the island, causing considerable damage to property. At this time the convention was in session which framed the present Constitution of the State of Texas. The impression produced by this hurricane led to the insertion of Sections 7 and 8, in Article XI. of the Constitution, granting all counties and cities bordering on the coast of Mexico the right to issue bonds and construct sea-walls, or breakwaters. Judge Wm. P. Ballinger, one of Galveston's most honored citizens and a lawyer of marked ability, was a member of this constitutional convention, and the author of the sections before named. On 28 Aug. 1886, having in mind a storm which swept the city on the 20th day of that month, Judge Ballinger addressed an open letter to the citizens of Galveston, calling to their attention

this constitutional provision and warning them of the great necessity for the construction of a sea-wall as a means of protection. This letter was a strong appeal, and while it provoked much newspaper discussion, no active steps were taken to carry out the plan offered. When the people of Galveston awoke from their night of death in September 1900, Judge Ballinger's plan was again brought to light, and, although the author had long since passed away, it required no new appeal to spur the then thoroughly aroused people to the point of action.

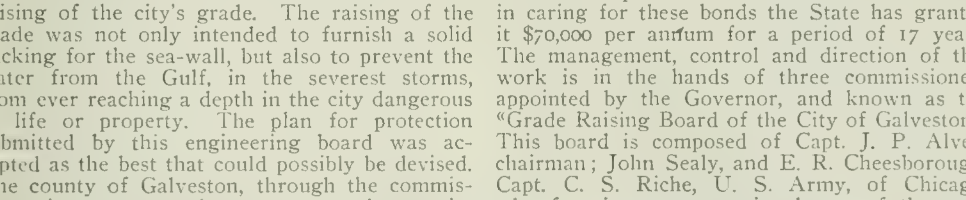
On 22 Nov. 1901, the Board of Commissioners of the city of Galveston appointed a Board of Engineers, consisting of Brig.-Gen. H. M. Robert, U. S. Army (retired), Alfred Noble, and H. C. Ripley, engineers of national renown, to devise a plan for the protection of Galveston against destructive overflows. On 25 Jan. 1902 this board submitted a plan calling for the construction of a solid concrete sea-wall and the raising of the city's grade. The raising of the grade was not only intended to furnish a solid backing for the sea-wall, but also to prevent the water from the Gulf, in the severest storms, from ever reaching a depth in the city dangerous to life or property. The plan for protection submitted by this engineering board was accepted as the best that could possibly be devised. The county of Galveston, through the commissioners' court, agreed to construct the granite concrete sea-wall, and provide a 150-foot right of way and filling for the same, with the understanding that the city proper, with aid from the State of Texas, would undertake the task of raising the grade.

Construction of the Sea-Wall.— This wall is now nearing completion. Its total cost, including the 150 foot right of way, will be $1,500,000. Its top is seven and one half feet above the extreme high water mark of September 1875, the highest ever known, excepting on 8 Sept. 1900, and it is one and three tenths feet higher than on that unprecedented occasion. The sea-wall, when completed, will be 17,593 feet in length, and is constructed on a piling foundation driven 43 feet in the ground, below mean low water, with a double thickness of sheet piling on the Gulf side. The wall is 16 feet at the base, 16 feet high, and 5 feet wide at the top, curving from the top to the base, as shown in sketch. The concrete is composed of one part of cement, three parts of sand and six parts of crushed granite. At intervals of three and one half feet, there is placed in the wall one and one half inch square, corrugated steel reinforcing rods 10 feet long. The rip rap in front of, or on the Gulf side of the wall is 27 feet wide, and from three to seven feet in thickness, and is composed of granite. The contract for constructing the wall was let to J. M. O'Rourke & Company, of Denver, Colo., on 9 Sept. 1902, with the provision that the work be completed in 15 months from date of contract.



CROSS SECTION OF GALVESTON SEAWALL & FILLING.

Raising the Grade.— In order to carry out the plan for raising the grade, the legislature of the State has authorized the city to issue bonds to the amount of $2,000,000 at a rate not to exceed five per cent. In order to aid the city in caring for these bonds the State has granted it $70,000 per annum for a period of 17 years. The management, control and direction of this work is in the hands of three commissioners appointed by the Governor, and known as the "Grade Raising Board of the City of Galveston." This board is composed of Capt. J. P. Alvey, chairman; John Sealy, and E. R. Cheesborough. Capt. C. S. Riche, U. S. Army, of Chicago, who for six years was in charge of the government engineer's office at Galveston, is the consulting engineer. The grade is to extend from the Bay eight feet above mean tide to seventeen feet at the sea-wall, thus forming a rise of one foot in 1,500 from the Bay to the Gulf. With this protection carried out, the city so protected will not be exposed to any danger from the waters of the Gulf.



Geo. W. Boschke,
Engineer in Charge of Sea-Wall Construction.

Galvez, gäl'väth, **Bernardo,** Count de, Spanish colonial administrator: b. near Malaga 1755; d. Mexico City 30 Nov. 1786. He entered the Spanish army in the Walloon guards, served also in the Cantabrian regiment of France (1772–5), and later fought with distinction un-

der Gen. O'Reilly in the war against Algiers. In 1776 he became lieutenant-governor of Louisiana, in the same year governor; and during the Revolutionary War, particularly after the Spanish declaration of hostilities against England in 1779, was of much service to the American cause. His capture of Pensacola and with it the Florida west coast (19 May 1781) was celebrated in verse by de Poydras. In 1783–5 he was captain-general of Cuba, and in 1785 was appointed viceroy of Mexico. His construction of a fortress-palace on the site of the castle of Montezuma at Chapultepec caused him to be misrepresented to the Spanish government as plotting the establishment of an independent Mexican kingdom. He improved the mines, increased the revenue, and alleviated the famine of 1785. He was one of the ablest of Spanish officials in the New World.

Galway, Ireland, a municipal and parliamentary borough, a seaport, and county of itself at the mouth of the river Corrib, on the north shore of Galway Bay, 50 miles north-northwest of Limerick. The old town is poorly built and irregular. The new town consists of well-planned and spacious streets, and is built on a rising ground which slopes gradually toward the sea and the river. Galway is the see of a Roman Catholic bishop, but is in the Protestant Episcopal diocese of Tuam. The principal buildings are the cruciform church (Episcopal) of Saint Nicholas (1320); St. Augustine's Roman Catholic church (1859), monasteries, nunneries, the county court-house, barracks, prison, infirmary, and Queen's College (1849). Galway has flour-mills, a distillery, a foundry, extensive salmon and sea fishing, a good harbor, with docks that admit vessels of 500 tons, and a lighthouse. During 1858–64 a line of steamers plied between Galway and the United States, but the service was abandoned in the last named year. The exports consist mainly of agricultural produce, wool, and black marble. It was taken by Richard de Burgh in 1232. From the 13th till the middle of the 17th century it continued to rise in commercial importance. In 1652 it was taken by Sir Charles Coote, after a blockade of several months; and in July 1691 it was compelled to surrender to General Ginkell. Pop. (1901) 13,244.

Galway Bay, a large bay on the west coast of Ireland, between County Galway on the north and County Clare on the south, about 30 miles in length and from 20 to 7 miles in breadth. Across its entrance lie the Aran Islands, and there are numerous small islands in the bay itself.

Gáma, gä'mä, **Antonio Leon de,** a Mexican scientist: b. City of Mexico 1735; d. 12 Sept. 1802. He was secretary to the supreme court for a number of years, and subsequently was a professor at the School of Mines. He is best known for his study of the celebrated Aztec calendar stone which was discovered in his time.

Gama, José, Basilio da, Brazilian poet: b. in the district of Rio-dos-Mortes, Brazil, 1740; d. Lisbon, Portugal, 31 July 1795. Educated by the Jesuits, he joined their order; but about 1786 renounced his allegiance to it, and published the poem 'Uruguay' to expose the alleged Jesuit design of forming an independent state among the Uruguay Indians. He was elected a member of the Academy of Lisbon. He also published 'Lenitivo da Sandade do Principe D. José' (1788), and 'Quitubia' (1791).

Gama, Vasco da, väs'kō dä, Portuguese navigator: b. Sines, Portugal, 1450; d. Goa, India, 24 Dec. 1524. He was the first navigator who made the voyage to the East Indies by the Cape of Good Hope. Bartholomew Dias, a Portuguese explorer, having visited the cape, which he called Cabo Tormentoso, or stormy cape, brought back such interesting accounts of his discoveries that the Portuguese sovereign Emanuel, following the policy of his predecessor, John II., determined to urge discovery beyond the point where Dias left it, and if possible to reach by sea the countries of the Indies. Accordingly an expedition was placed under the command of Vasco da Gama, a gentleman of the king's household, and a skilful and experienced mariner. The fleet consisted of the San Gabriel, flag-ship of 120 tons, the San Rafael of about 100 tons, a caravel of 50 tons, and a store-ship, with a total force of 160 men. The king presented Gama with the flag of the military order of Christ (a white cross within a red), also the journal of Covilham the navigator, who had 10 years before gone to India by way of the Red Sea, and with letters to all known potentates, and to the mysterious Prester John. On 8 July 1497 Gama's expedition departed from Lisbon for the Cape Verde Islands, whence it set sail on 3 August southward along the African coast. For three months the voyagers pursued their way, harassed, as an early English narrator says, with torments of wind and rain. On 7 November they put into a bay called St. Helena, near the cape, where they found the natives "lyttle men, ill favored in the face and of color blacke, and when they did speake it was in such manner as though they did alwayes sigh." Departing on the 16th, they encountered a succession of tempests such as had gained for the southern promontory of Africa the name of the Cape of Storms. The courage of Gama's companions failed, and they besought him to put back, which he not only refused to do, but put the ringleaders of the movement in irons, and held on his course into the stormy sea. When they were beating about off the promontory, Gama fancied that he saw the spirit of the cape. Camoens has sung this incident as a fact, while moderns, less poetical, say that the apparition could have been nothing more than that peculiar cloud whose sudden envelopment of the cape is the forerunner of a storm. On Wednesday, 20 November, they doubled the Cape of Storms, or rather, as Emanuel himself had named it ere the expedition set out, the Cape of Good Hope. Proceeding along the coast, they touched at various points, among others at Natal. Further north they discovered Mozambique, and came upon a country which exhibited a high stage of commercial advancement, the inhabitants having regularly built ports, with mosques. The natives were Mohammedans, carrying on a trade in pearls, rubies, silver, linen, and spices with Arabia and India. Gama took with him a pilot from this place. On 1 April the explorers discovered the island of Açoutado, which Gama so named from a flogging he gave to his pilot there; and on the 7th the island of Mombassa, where the people who inhabited it were bravely apparelled in silken

stuffs and jewelry. As these men tried to cut his cable, Gama seized a boat containing 17 of them, and carried them off to Melinda, 3° south of the equator, where the king of the place entered into the most friendly relations with the Portuguese, and gave them a pilot to conduct them across the Indian Gulf. Melinda was described as a regularly built city, with wide streets and houses of more than one story. The Melindese pilot is reported to have been acquainted with the astrolabe, compass, and quadrant. Under his guidance the voyagers steered 750 leagues across the open sea. In 23 days they arrived off the Malabar coast, and on 20 May 1498 they reached Calicut, the object of their search. Their mission was thus accomplished, and a new route to the East established. Gama's relations with the ruler of Calicut, who was called the Samoudri-rajah (abbreviated to Zamorin) were not of a cordial nature; and therefore, leaving the Indian coast on 15 October, Gama returned to Lisbon, calling at Melinda on the way to take on board an ambassador to Emanuel's court, and arriving in the Tagus September 1499, after an absence of two years and two months. He brought back only 55 men and one ship, a caravel which he had chartered at Cape Verde. The San Rafael had been lost on the coast of Africa, the store-ship burned according to Gama's instructions, the San Gabriel condemned at Cape Verde, and Nicolao Goelho had slipped away with the remaining vessel in order to be the first to tell the great news in Portugal. The king received Gama splendidly, and permitted him to bear the high-sounding title of "lord of the conquest of Ethiopia, Arabia, Persia, and India."

Emanuel immediately fitted out a second fleet of 13 ships, with 1,200 men, under the command of Pedro Alvarez Cabral, to establish trading posts; but failing in its ends, another fleet of 20 ships was placed under command of Gama. This expedition, which was warlike in its character, sailed early in 1502. On reaching Calicut, Gama immediately bombarded the town, enacting deeds of inhumanity and savagery too horrible to detail, and equaled only by the tortures of the Inquisition. From Calicut he proceeded in November to Cochin, "doing all the harm he could on the way to all that he found at sea," and, having made favorable trading terms with it and other towns on the coast, he returned to Lisbon in September 1503 with richly laden ships. He and his captains were welcomed with great rejoicings; "but to Dom Vasco the king gave great favors, and all his goods free and exempt; he granted him the anchorage dues of India, made him admiral of its seas forever, and one of the principal men of his kingdom." Soon after his return Vasco retired to his residence in Evora, and for 20 years took no part in public affairs, either from pique at not obtaining, as is supposed by some, so high rewards as he expected, or because he had in some way offended Emanuel. During this time the Portuguese conquests increased in the East, and were presided over by successive viceroys. The fifth of these was so unfortunate that Gama was recalled from his seclusion by Emanuel's successor, João III., created count of Vidigueira, and nominated viceroy of India, an honor which in April 1524 he left Lisbon to fill. Arriving at Goa in September of the same year, he immediately set himself to correct, with vigor and firmness, the many abuses and evil practices which had crept in under the rule of his predecessors. He was not destined, however, to prosecute far the reforms he had inaugurated, for on Christmas eve following his arrival he died, and was buried in the Franciscan monastery there. In 1538 his body was conveyed to Portugal and entombed in the town of Vidigueira, of which he was count, with all the pomp and honor due to one who had been the king's representative. The important discoveries of Vasco da Gama had the result of enriching Portugal, and raising her to one of the foremost places among the nations of Europe.

Gama'liel ("God is a reward"). Two persons of this name are mentioned in Bible history. The first, Gamaliel, the son of Pedahzur, in the book of Numbers, i. 10; ii. 20; vii. 54, 59; x. 23, as prince or head of the tribe of Manasseh. The other and better known Gamaliel is mentioned twice in the Acts of the Apostles. In both passages he appears as a learned doctor of the law, of the sect of the Pharisees. From the one we learn that he was the preceptor of St. Paul, who was brought up in Jerusalem, "at the feet of Gamaliel." In the other we find him advising the council of Sanhedrim in regard to their treatment of the apostles, and it is the advice given on this occasion which has rendered him famous. "If this counsel or this work," he said, "be of men it will come to naught, but if it be of God ye cannot overthrow it, lest haply ye be found to fight even against God." Ecclesiastical tradition makes Gamaliel become a Christian, and relates that he was baptized by St. Peter and St. Paul; but the story does not appear to be supported by any evidence. He has been identified by scholars with Gamaliel, the son of Simeon and grandson of Hillel, president of the Sanhedrim under Tiberius, Caligula, and Claudius.

Gamarra, gä mär'rä, **Augustin**, Peruvian general: b. Cuzco 27 Aug. 1785; d. Yngavi 20 Nov. 1841. He fought in the Spanish army in 1809–21, then joined the patriots, marched into Bolivia (1827), and effected the Treaty of Pisagua (1828). From 1829 to 1833 he was provisional president of Peru, and later was variously identified with the political disturbances of the time. In 1837 he took a leading part in Chilean opposition to the Bolivia-Peru confederation, and upon the conclusion of a successful campaign became president of Peru (1839). He was killed in battle during an invasion of Bolivia.

Gamba, a stringed instrument of the viol sort, called also viola da gamba, with six strings, weaker in tone and smaller in size than the violoncello, so called because it was held between the knees of the player, as distinguished from viola da braccia, played on the arm. Also an organ stop, the pipes of which are, in continental organs, generally cylindrical, of small scale, and well cut up, but sometimes conical in shape. Its tone is pungent, and not unlike that of a violin or violoncello.

Gambado, or **Gambade**, a leather legging for equestrians; it is wrapped round the leg, reaching from the knee to the foot, and is fastened at the side by clasps.

Gambetta, Léon Michel, lā-ôṅ mē-shĕl gän-bet-tä, or găm-bĕt'tä, French statesman: b. Cahors, France, 3 April 1838; d. Sevres,

France, 31 Dec. 1882. He was of Genoese extraction; was educated for the Church; but finally decided in favor of the law; and going to Paris became a member of the metropolitan bar in 1859. In November 1868 he gained the leadership of the republican party by his defense of Delescluze, a noted republican. In 1869, having been elected by both Paris and Marseilles, he chose to represent the latter city; and in the Chamber of Deputies showed himself an irreconcilable opponent of the empire and its measures, especially of the policy which led to the war with Prussia. On the downfall of the empire, after the surrender of Sedan in 1870, a government for national defense was formed, in which Gambetta was nominated Minister of the Interior. The Germans having encircled Paris, he left that city in a balloon, and set up his headquarters at Tours, from which, with all the powers of a dictator, he for a short time organized a fierce but vain resistance against the invaders. After the close of the war he held office in several short-lived ministries, and in November 1881 accepted the premiership. The sweeping changes proposed by him and his colleagues speedily brought a majority against him, and after a six weeks' tenure of office he had to resign. The accidental discharge of a pistol caused his death. See Reinach, 'Léon Gambetta' (1884); Harrison, 'Leon Gambetta, a Positivist' (1892); Tournier, 'Gambetta' (1893).

Gam'bia, (1) A British colony in West Africa, occupying portions of territory at the mouth of the river Gambia, some of its islands, and about six miles of land on either bank for a distance of 250 miles from the sea, and the navigable waters of the Vintang Creek. It thus forms a narrow strip running through French territory; total area, about 2,700 square miles. The principal settlement is Bathurst, at the mouth of the river. There is comparaively little fertile land, and agriculture is primitive. Gambia differs very little from the other West African settlements in point of unhealthiness. The position of Bathurst, the seat of government, is very unhealthy in the rainy season. There are a number of Anglican, Roman Catholic, and Wesleyan schools in the colony. Cotton cloth is manufactured to some extent by the natives, who also prepare palm-oil, build boats, etc. The principal exports are groundnuts, rubber, beeswax, ivory, hides, gold and palm-oil. The value of imports in 1900 was over $1,385,000 and the exports amounted to $1,410,000. Gambia is a crown colony under an administrator, who is assisted by an executive and a legislative council. The population of the entire region in 1901 was about 90,000, including about 200 whites, the remainder being chiefly negroes. (2) A river flowing through the above colony and giving to the colony its name. Rising in the mountains of Senegal, after a course of about 700 miles it expands into a broad estuary and at Bathurst enters the Atlantic Ocean. For nearly 300 miles it is navigable by seagoing vessels.

Gambier, găm'bēr, **James,** Baron, English naval officer: b. New Providence, Bahamas, 13 Oct. 1756; d. near Uxbridge, England, 19 April 1833. He entered the navy, and off Ushant fought with distinction as commander of the Defence under Lord Howe in 1794. As admiral he commanded the British fleet at the bombardment of Copenhagen in 1807, and was rewarded with a peerage. At the action in Basque Roads in 1809 he refused to act on the advice of Lord Cochrane, was tried by court-martial, and acquitted. He attained the rank of admiral of the fleet in 1830.

Gambier, Ohio, village of Knox County, on the Cleveland, A. & C. R.R., 50 miles north of Columbus. It is noted for its educational institutions, including Kenyon Episcopal College (q.v.), Kenyon Military Academy, Bexley Theological Seminary, and the Harcourt Female Seminary. Pop. (1900) 751.

Gambier Islands, a group of small islands of the South Pacific, about lat. 23° 8′ south, and lon. 134° 55′ W. The natives are a well-formed race, and have made some progress in civilization. On Mangareva, the largest of the group, some French missionaries settled in 1834, and the islands now belong to France. The total population is about 1,200.

Gambir, găm'bēr, or **Gambier,** called also *Terra japonica,* an astringent substance obtained from the *Uncaria gambir,* a tree of the family *Cinchonaceæ,* cultivated in Sumatra and other islands of the Malay archipelago. It is obtained from the leaves by boiling or infusing them in water, inspissating the resulting fecula, and forming into cakes. The Chinese use it for chewing, and in the western world, principally in Great Britain, it is employed in dyeing and tanning, also medicinally. It is mostly exported from Singapore. It is often considered as one of the articles of catechu (q.v.).

Gamble, Hamilton Rowan, American statesman: b. Winchester, Va., 1798; d. 1864. He was admitted to the bar in Virginia, settling in Missouri 1818, and being elected Secretary of State of that commonwealth 1823. Practising law at St. Louis he became judge of the Supreme Court and was elected a member of the Constitutional Convention 1861 and appointed by it governor, in place of C. F. Jackson, who had become a secessionist.

Gambling, or **Gaming,** the practice of playing for a money stake games depending solely on chance, like roulette, for instance, or those other games into which the element of skill enters, as in the cases of whist or billiards. Strictly speaking, gambling may be understood as gaming in its worst sense, and as implying professional play for a money stake by men who are unscrupulous adepts at so-called games of chance. Gambling has been common among most nations, civilized and uncivilized. The practice of civilized communities in regard to these acts has been far from uniform. The odium of gambling has sometimes been attached to games perfectly innocent in themselves, and these games have been prohibited to the manifest prejudice of the law, which has thus been brought into dishonor and contempt. At other times, governments, tempted by the facilities of sharing in the dishonest gain, have openly and shamelessly encouraged gambling by licensing gaming-houses, or instituting lotteries under their own authority. See Lottery. In England gambling was early made the subject of penal enactments. Statutory restrictions upon games and gaming go back as

far as Richard II. In France, public gaming-tables were suppressed from 1 Jan. 1838. Previous to the formation of the new German empire gambling was encouraged by official countenance in several of the principalities of Germany. Baden-Baden, a watering-place in the grand-duchy of Baden, and Homburg, then in the landgravate of Hesse-Homburg, were until comparatively recent times the two most famous resorts in Europe of the frequenters of gaming-tables. Since the suppression of gambling in these places, after the formation of the empire (31 Dec. 1872), the principality of Monaco in Italy has become the last public resort of this species of gambling in Europe.

In the United States the keeping of a gambling-house is indictable at common law as injurious to morals; and most States and Territories have passed laws against gambling, some of them severe and stringent. Yet till 1880 gambling was common and open in many parts of the United States; and it was left largely to societies for the suppression of vice, especially in New York, to stir up the authorities to put the laws in force. In 1881–4 prosecutions and convictions were very numerous; in 1885 almost all the chief cities in the Union followed the example of New York, and since that time the progress of legislation on this subject has been noteworthy in many of the States. Always there is difficulty in legally defining gambling and distinguishing in judicial practice between acts which violate the gambling laws and those which, while presenting some questionable appearances, are yet not obviously to be classed in the same category. As in so many other matters of public policy, there is also a loss of power to the regulative sentiment of the people through want of uniformity or any considerable degree of identity among the laws of various States and sections. Therefore it is scarcely strange that, in spite of all prohibitive legislation and repressive influences brought to bear by public opinion, gambling should, either through connivance of the authorities or by secrecy and evasion, continue to be practised in many of the large cities of the United States. As in all other matters of public interest, the moral sentiment of the community steadily seeks and no doubt gradually finds a controlling expression through its official representatives in the legislative field and in local and general administration. Consult: ‹Encyclopædia of the Laws of England›; Brandt, ‹Games, Gaming, and Gamester's Law›; Ashton, ‹History of English Lotteries›; Bishop, ‹On Statutory Crimes› (1901).

Gamboge, găm-bōj′ or -booj′, a gum-resin derived from *Garcinia hanburyi,* a member of an extremely large family of the eastern tropical countries. The gamboge tree itself is a native of Siam, Cochin-China, Cambogia, from which places the drug is imported to Europe and to the United States. Other forms of gamboge are found in India, China, and the Asiatic Islands that are rarely seen in the American market. The gum-resin is obtained by cutting or wounding the trunks of the trees causing a bright yellow juice to flow. This is collected, usually in bamboo joints and hardens naturally, or is dried over a fire, until a solid mass results, which generally takes the shape of the collecting vessel. In the drug market pipe gamboge, press gamboge, and cake gamboge are recognized. Pipe gamboge is preferred because it is usually clean. As a pigment for painting, gamboge has been known for centuries, and as a purgative it has been used in China as long as history gives any definite information.

The gum-resin contains a large amount of gum, 15 to 20 per cent, and 70 to 80 per cent of a yellow resin-gambogic acid, on which its purgative properties depend. Taken into the body in doses of from two to five grains, it acts as a very active hydragogue cathartic, producing numerous watery stools, with much griping. It is principally valuable when combined with some other drug that tends to diminish the pain, and it is one of the most important ingredients in the compound cathartic pill of the United States Pharmacopœia, which contains one quarter of a grain of the resin. Overdoses cause violent poisoning with intense prostration.

Gam′brell, James Barton, American Baptist minister and editor: b. Anderson County, S. C., 21 Aug. 1841. He was graduated at the University of Mississippi, and served as a captain of scouts in the Confederate army during the Civil War. He was ordained to the ministry in 1867 and held several pastorates. He served as editor of the ‹Southern Baptist Record› for many years, and was elected president of Mercer University, Georgia, 1893.

Gambrinus, găm-brī′nŭs, a mythical king of Flanders, inventor of beer, said, probably incorrectly, to have an original in Jan Primus (or Jan I.), duke of Brabant. He is represented in Germany as Saint Gambrinus, patron of drinking. His figure is familiar in German beer-cellars, often seated astride a cask, a foaming tankard in his hand.

Game-fowls. See Cock-fighting; Poultry.

Game Laws, are legislative enactments adopted by nations and states to prohibit or regulate the killing of wild animals, birds, and fishes. In Great Britain the game laws are a relic of the forest laws, which in the time of the Norman kings were so oppressive; it being under the Conqueror as great a crime to kill one of the king's deer as to kill one of his subjects. A certain rank and standing, or the possession of a certain amount of property, were for a long time qualifications indispensably necessary to confer upon any one the right of pursuing and killing game. By the Game Act of William IV., the game laws were greatly modified, the necessity for any qualification except the possession of a game certificate being then abolished, and the right being given to any one to kill game on his own land, or on that of another with his permission. Every uncertificated person selling game is also required to take a yearly license. The animals designated as game by this act are hares, pheasants, partridges, grouse, heath-game, or moor-game, black-game, and bustards. These animals (with the exception of hares) are not allowed to be killed at all times, there being a certain season of the year — the close season — during which all and sundry are prohibited from killing game. By an act of 1880 every occupier of land has a right, as inseparable from and incident to the occupation of the land, to kill and take ground game (hares and rabbits) thereon, concurrently with any other duly authorized person, all

agreements in contravention of this right being declared void. Game laws of greater or less strictness are in force in many other countries. In Canada the chief restrictions are in regard to killing wild animals during the breeding season.

In the United States wild game whether of forest, field, or stream is perhaps better protected than in any other country in the world. Although there are certain general national laws, 28 States have passed game laws of their own, and as many States have organized societies for the protection and preservation of game. There are 8 national organizations, the most important being the League of American Sportsmen; G. O. Shields, president, New York. The others are: the American Ornithological Union, the National Sportsmen's Association, the National Bird, Game and Fish Protective Association, Bird Protective Society of America, Boone and Crockett Club, International Forest, Fish, and Game Association and North American Fish and Game Protective Society. Nearly every State in the Union has now a Game and Fish Commission and numerous game wardens.

The national game law, known as the Lacey Law, passed by the Congress in 1900, gave to the Department of Agriculture certain powers, by which among other provisions no importation of wild animals, birds, or fishes could be made without a permit from the secretary of agriculture.

Two important Federal laws relating to game were passed during the year 1902: (1) An act amending the tariff act so as to permit the importation of the eggs of game birds for propagation, and (2) an act protecting game in Alaska. The Alaska act, which is the first general game law of the Territory, fixes close seasons and prohibits export and sale, though permitting shipment of specimens and trophies for scientific purposes under regulations made by the secretary of agriculture. Legislative sessions were held in less than one third of the States and Territories, but in nearly every case some changes were made in laws for the protection of game. General game laws were enacted by Kentucky, Louisiana, and Ohio. The adoption of non-export provisions in several States reduces the number of States which permit unlimited export of game to three, all in the South. Three States — Kentucky, New Jersey, and Ohio — adopted the license system, by which non-residents are required to secure licenses to hunt, fixing fees of $10 in New Jersey and $25 each in Kentucky and Ohio. Non-resident licenses at rates ranging from $5 to $40 are now required in half the States and Territories and in nearly all the Provinces of Canada. Arkansas and Oregon, however, require licenses only for market hunting, and New York only from residents of States which demand similar licenses from residents of New York. Louisiana and Missouri do not permit non-residents to kill game within the State. Additional restrictions on the sale of game were adopted in South Carolina, and a statute allowing dealers to hold their game under bond during the close season was passed in New York.

The movement toward securing uniform laws for the protection of song, insectivorous, and other non-game birds made substantial progress during 1902. Alaska, Kentucky, and Ohio extended protection to birds other than game, increasing the number of States which now have a practically uniform law of this kind to 19. A similar law was adopted for the Northwest Territories, Canada, and the legislature of Maryland passed a law of like character for Washington County.

New York in 1902 raised the number of its game protectors from 38 to 50, and New Jersey has given its wardens additional powers to make searches and seizures. In Oklahoma the territorial authorities seized several large consignments of game en route to eastern markets contrary to law, and have taken steps to secure a more stringent enforcement of the non-export laws.

Under the Lacey Act numerous seizures were made of game shipped from the West and Southwest, and proceedings were instituted in a number of cases in State and Federal courts. In some of the cases in Iowa and South Dakota convictions were secured with penalties ranging from $150 to $200. The inspection of foreign birds at the port of New York was made more effective, and special inspection service was established in Hawaii and extended in scope so as to prevent the introduction of noxious reptiles into the islands.

Even more important than the enactment of new game laws has been the work of game commissions and voluntary organizations interested in the practical protection of birds and game. In 1902 important changes were made in the game commissions of Ohio and Vermont, and a new territorial warden was appointed in Oklahoma. Several sportsmen's game and fish protective associations were added to the large number already existing, and new Audubon societies were organized in Louisiana, Nebraska, North Carolina, Oklahoma, and Oregon. Thirty-two States now have Audubon societies, which are formed primarily for the protection of birds other than game. The committee of the American Ornithologists' Union on the protection of birds extended its work along the coast, and now maintains supervision of all the breeding colonies of sea birds on the Atlantic coast from Eastport, Me., to Chesapeake Bay, as well as at some points in Florida.

Practically all the State game laws passed by the various State legislatures prohibit the export of game, hunting, or fishing for commercial purposes, and hunting big game with dogs. In a few States the netting of minnows for bait is also prohibited. The killing of song birds is forbidden in most of the States, but this law does not apply to the hawk, owl, crow, blackbird, and English sparrow. Hunting and fishing in the national Yellowstone Park is prohibited.

While the close and open season for hunting and fishing are well defined in all the States, there is no general statement which can cover the question, the seasons and conditions varying so widely. In Alabama, for instance, deer may be shot for four months only (September to January) in Indiana all the time, and in Illinois no deer can be shot until 10 May 1906. All State game laws are peculiarly adapted to local conditions. See AUDUBON SOCIETY; FISHING; HUNTING.

Game Preserves, or **Game Parks,** are large reservations of land, usually including mountain and forest, set aside by the government or

individuals, for the propagation and preservation of game. Game preserves have been well known in Great Britain and on the Continent for upward of five centuries. Henry VIII. established a royal deer park near Hampton Palace in 1526, and the Duke of Sutherland at the present day owns the largest game preserve in the world. Game preservation in the United States first attracted attention just prior to the Civil War and later when the rapidly increasing settlement of the States threatened the extinction of all kinds of wild game.

The United States government took up the question of game preservation almost as soon as the individual, and the establishment of the Yellowstone National Park in the Rocky Mountains, and the Yosemite National Park in California had as much to do with the protection of big game as in the preservation of forests. In these two reservations the government ranges have endeavored to preserve and protect such large game as the buffalo, elk, and moose. In 1902, President Roosevelt, himself a hunter of big game, declared no less than 12 new national forest reserves, which while largely important to forestry, will greatly assist in the protection of big game. These new reserves have a total area of 14,276,476 acres, which makes a grand total of government parks and reservations of 60,162,525 acres. The new reserves added in 1902 were as follows:

	Acres
The San Isabel, Colorado	77,980
The Santa Rita, Arizona	337,300
The Niobrara, Nebraska	123,779
The Dismal River, Nebraska	85,123
The Santa Catalina, Arizona	155,520
The Mount Graham, Arizona	118,600
The Lincoln, New Mexico	500,000
The Chiricahua, Arizona	169,600
The Madison, Montana	736,000
The Little Belt Mountains, Montana	501,000
Alexander Archipelago, Alaska	4,506,240
The Absaroka, Montana	1,311,600

Of private game parks in the United States, the first of record was that of Judge J. D. Caton, of Ottawa, Ill., the author of ‘Deer and Antelope in the United States.’ This he established in 1860, for sport and study, bringing together on his large estate many varieties of game animals native to America. In 1889, Austin Corbin enclosed the largest preserve in the United States, and next to that of the Duke of Sutherland, the largest in the world. It is known as Blue Mountain Forest and is situated near Newport, N. H. It contains over 36,000 acres, and is surrounded by a wire fence, 8 feet high, forming an oblong tract 12 by 5 miles, and which is crossed by a mountain range, the peaks of which are 3,000 feet high. Here are miles of wooded slopes, dense forests, and broad meadows, giving food and shelter to all kinds of game animals, from the buffalo, elk, and moose to the smaller species. The experiment has been most successful, nearly all of the animals thriving and increasing rapidly in numbers. In 1870, F. S. Giles laid out the Grove Park reservation, containing 17,000 acres, and this experiment was followed by Dr. W. Seward Webb with a preserve of 9,000 acres at Nebasane, N. Y., in the Adirondacks, and another preserve at Shelburne, Vt. The Litchfield Park at Tupper Lake, N. Y., in the Adirondacks, was established in 1893, with 9,000 acres, and in 1900 hundreds of herds of large game were roaming the mountain forests within this tract. In the same region the Adirondack Timber Company has a park of over 30,000 acres, well stocked with animals. George W. Vanderbilt at his Carolina estate of Biltmore, has 80,000 acres, 6,000 acres of which are enclosed and well stocked with game. A small army of men are engaged here as keepers. In many of the smaller parks particular attention has been paid to game birds, such as the English pheasant, prairie chicken, and wild turkey. A lover of birds imported large numbers of Japanese pheasants for his preserve in Oregon in 1893, the experiment proving a great success. E. C. Benedict, of Greenwich, Conn., has established extensive fish preserves in Long Island Sound, which are the largest and most successful of their kind in this country. Near Plattsburg, N. Y., Paul Smith owns an immense preserve around St. Regis Lake of 40,000 acres. Large numbers of elk were brought here from the West in 1903. William C. Whitney of New York has been active in stocking the Adirondack region with big game, and in conjunction with Dr. F. E. Kendall, of Saranac Lake, has restocked the forests with elk and deeer. At Delaware Water Gap, Pa., on the New Jersey side of the Delaware River, Barclay Warburton, of Philadelphia, established in 1902 an extensive deer park, which is one of the most successful in that section of the country.

In Canada there are several large game preserves, prominent among which is the Caughnawaga reservation on the Maquacippi River. The Roberval Club, which has a membership of 300, including both American and Canadian, owns a big game preserve containing 500 square miles, located in the Laurentian Mountains. Henri Menier occupies as a game park the whole of Anticosti Island, in the Gulf of St. Lawrence.

Games. Games are an expression of the play instinct, a distinct species or form of play. A study of them includes a definition of games as distinguished from play; and a consideration of games from historical, educational, and recreative viewpoints. While the term play includes games, so that we "play games," it is technically applied to informal play activities, such as playing horse, playing house, and playing in the sand. In such play there are no fixed rules, no formal mode of procedure, and generally no climax to be achieved. The various steps are spontaneous, not predetermined, and are subject to individual caprice. In games, on the contrary, as in blindman's buff, prisoner's base, or football, there are prescribed acts, subject to rules, generally penalties for the infringement of rules, and the action proceeds in a formal evolution until it culminates in a given climax; which generally consists of a victory of skill, speed or strength. This definition applies to games that require considerable bodily activity, such as those mentioned, and to so-called quiet games, as dominoes, cards, jackstraws, chess, checkers and other board games. Our concern in this article is chiefly with active games.

Among the simplest of active games are singing games, in which the action is mainly a repetition of dance movements, or of some dramatic or descriptive motions, as when the farmer sows his seed or London Bridge falls down upon its victim. More strenuous are the games of chase, such as tag, cat and rat, and

Red Rover; or competitive games of skill, strength or speed, illustrated by relay races and athletic contests. Highest of all, both in their organization and their demands upon the varied powers of players, are team games, of which baseball and football are popular examples. Team games are peculiar to the Anglo-Saxon race; nearly all games of the other classes are of very ancient origin and of wide distribution among the races and nations of men. Indeed, the games of children form a distinct branch of anthropology, ethnology and folklore, and throw much light on early customs from which they are descended; for they come trooping out of the past unconsciously bearing the relics of primitive civilizations, of old religious rites and grim superstitions, of marriage and May-time festivals and "battles long ago." "Oats, peas, beans, and barley grows" had its origin in a religious rite intended to increase the fertility of the fields; "London bridge," in the offering of a human sacrifice at the building of a bridge; "Here we go round the mulberry bush" is the survival of a custom, still practised by some of the European peasantry, and known to have existed at least as far back as the early Greeks, of celebrating May day or spring time with the gathering of flowers and marching in procession. This usage prevailed among the American colonists, and from it have come our May basket and May pole customs. Indeed, most of these singing games and many other active parlor games now played by children, such as stage coach, and going to Jerusalem, were used instead of the dance by the young people of the Puritan era. Among the games of religious or superstitious origin tag should be mentioned, which, in its earliest form of iron tag, represented flight from an evil spirit, against whose influence iron was a protection. The little kindergarten game, "I put my right hand in," is very ancient, and with its chorus "Looby loo" gives evidence of having been part of a religious rite to some deity. In time it became a stately court dance, which rank it held a century ago. From the superstitious customs of divination by lot have come the doggerel "counting out" rhymes used by children the world over for choosing the principal players in games. Familiar are the stanzas of this kind beginning "Ena, mena, mina, mo," and "Onery, twoery, tickery, tee." Of similar derivation is the custom of assigning parts by "holders," in which one child holds a pebble in the closed hand, and another guesses which hand contains it. Courtship and marriage customs are perpetuated in "Round and round the village" and "Little Sallie Waters." Still other games, for example, "Uncle John is very sick," come from the ballad days when a versified narrative was sung and acted at the same time;—days when to "sing a dance" and "dance a song" were interchangeable terms.

Athletic games, or competitive trials of individual strength, speed or skill under fixed rules, are probably pre-historic. The mention of them takes one's thought at once to "the glory that was Greece and the grandeur that was Rome." The Greek games have been immortalized in literature and art; prominent examples of which are the Iliad and Odyssey, Pindar's 'Odes of Victory,' and, in sculpture, the discobolus or discus thrower, and the wrestlers. These Greek games were played at four stated festivals, the greatest being the Olympic, which became a national festival about 776 B.C., and recurred every four years at Olympia in Elis. The importance of the Olympic festival in Greek national life may be judged from the fact that time came to be reckoned in Olympiads. The Pythian games were celebrated in the third year of each Olympiad, the Nemean games in the second and fourth years of each Olympiad, and the Isthmian games in the first and third years of each Olympiad. All were held in honor of some god. In Homeric times the events in athletic games were chariot racing, boxing, wrestling, foot racing and javelin throwing. The Olympic contests, which came later, were probably confined at first to foot racing; to this other events were gradually added until the pentathlon came into existence, about the 18th Olympiad, and boxing and chariot racing were added in the 23d Olympiad. The pentathlon consisted of leaping, spear throwing, discus pitching, running and wrestling. It thus called for "all-over" work, thereby preventing inharmonious development by over-specialization. A competing athlete was obliged to enter for all five contests and was considered a victor only upon winning at least three of the five events. The best modern athletic games embody these principles in what are called group contests. For instance, in the pentathlon of the Young Men's Christian Association, the 100-yard dash is equivalent to the Greek foot race; throwing the 12-pound hammer is equivalent to discus throwing, the running high jump to leaping; pole vaulting for height is a substitute for hurling the spear, and the one-mile run for wrestling. The prizes for the Greek games had no intrinsic value and were merely symbols of honor, as wreaths or palm branches. The prestige and indirect advantages accruing to a victor, however, became in time so great that contestants spent all of their time training for the games. The entrance of this professional and commercial spirit led to the decadence of the games. A similar degeneration occurred much more quickly in Rome. In these latter days we have had the dramatic spectacle of the revival of the Greek games as international contests, the first of these occurring in Athens in 1896. The countries represented by the contestants in these international games included: Germany, England, Austria, France, Italy, Switzerland, Sweden, Hungary, Denmark, Greece, Australia, and the United States.

No mention of the Greek games would be adequate that did not include the balanced relation which they held to the intellectual, artistic and ethical interests of the time. The contestants were examples of balanced culture, and the festivals drew together the greatest poets, philosophers, orators, and artists whose achievements were there displayed. The tournaments or jousting bouts of the age of chivalry may be cited as a further example of athletic contests of great popularity in which the concern for physical prowess was blended with higher interests. It is notable that the modern organizations which have made physical training most popular, the German Turnverein, the Young Men's Christian Association, and the colleges, also combine these varied elements.

Ranking higher as games than individual contests, because more complicated in their organization and demands, are team games in which opposing groups contest, each as a unit against the other. Each player on such a team has his assigned part or duties, differing from many of the others, but as an individual he is subordinate to the interests of his team. Games of this class are an expression of the fighting instinct, and undoubtedly are a development from the simpler fighting games played by young boys, such as stealing sticks (Scots and English), and prisoner's base, which in turn are supposed to have originated in border warfare. Between these simpler games and the highly developed team games there exists the same differences of organization as between primitive and modern warfare. The former was merely a series of individual combats, the parts enacted by the various contestants being homogeneous, and, the fight once on, very largely a matter of individual initiative. In modern warfare there is greater differentiation of duties, and the individual is subordinated to the organized whole. The team games most popular in the United States are baseball, football, basket ball, cricket, and hockey. Baseball has been called the national game of the United States, as cricket and Rugby football are distinctive of England, golf of Scotland and hand ball of Ireland. Basket ball bears the unique distinction of being the only game of wide and enduring popularity which was deliberately invented. Dr. James Naismith devised the game about 1892, as a result of studying the principles involved in successful games. Though invented for and played by men, it is the only team game that has become popular with women. Competitive adult games largely in vogue, which depend upon skill, rather than upon a combination of skill and organization, are tennis, golf and croquet.

The anthropological tenet, that in his development the child passes through the stages which the race has gone through before him, finds strong confirmation in children's plays and games. "The work of adults in one age of human history becomes the play of children in another." While the play of civilized children, as of savage, shows imitations of current adult activities, nearly all of the games of civilized children would seem to take their players through the primitive culture epochs. Just what this, or the lack of it, may mean for individual development we cannot say; but it may be inferred from the direct training of power which games provide. The value of this training assumes a clearer position in the light of one of the fundamental concepts underlying the science of education, that of the meaning of the long period of human childhood. Prof. John Fiske pointed out in his 'Outlines of Cosmic Philosophy,' and President Nicholas Murray Butler elaborated in 'The Meaning of Education' the significance of the long interval between birth and maturity in the human species as compared with animals. This significance lies in the importance of adaptation to environment as an element of survival. The animal that lives in a comparatively simple environment, and for which reflex actions are sufficient to maintain life, as the chicken that pecks for food, has but a brief period between birth and maturity. The more complicated environment of the human species, intellectual, industrial, sociological, aesthetic, ethical and spiritual, in which intelligence takes the place of reflex action, calls for a much longer period for adaptation.

The function of education is to assist in this adaptation, and it needs not to be said in an age of the kindergarten that play is one of nature's great means of education, and therefore of adaptation. "Animals play," says Karl Groos, "not because they are young: rather they have a period of youth because they need to play." And the same may be said of children. Physically, mentally, morally, socially, play develops the child, and in that development games have an important and often a unique part. All of the games here passed in review give expression to simple instincts which are basic to strong and effective character and therefore help to develop those instincts. Prof. William James says, "All simple, active games are attempts to gain the excitement yielded by certain primitive instincts, though feigning that the occasions for their exercise are there. They involve imitation, hunting, fighting, rivalry, and acquisitiveness, combined in various ways."

Physical development would obviously result from playing active games. Especially in all running games are strength and endurance of heart, lungs, and related organs cultivated. Neuro-muscular development becomes apparent in agility and skill, from the stumbling child who learns to dodge quickly and skilfully to the expert ball player. Sense organs become more acute. Various powers of the mind are likewise developed and strengthened by the demands made upon them. Sense perceptions gain in rapidity and accuracy, so that a player sees or hears more quickly that which comes in his direction or takes place around him; feels more quickly the touch upon the shoulder that makes him "it." Reactions become quicker and more exact, whether they be the simple reactions of ball catching, or the complicated ones involving reason and judgment, as when one grasps the shifting conditions of a rapid game with many players, and with swift decision adapts his own movements to them. For socionomic training games have peculiar potency; they develop power of co-operation; the sense of, and ability for, social relations, for taking a part in a social whole. Selfishness gives way to generous recognition of ability, and acknowledgment of superior ability, in others; and, highest of all, self is subordinated to the interests of a group. This self-subordination is a distinctive feature of team games, and perhaps does more than anything else to give them high rank in the hierarchy of games. It frequently happens in such games that a player must lose an opportunity to make a brilliant display of his own powers for the sake of a larger advantage to his team. True team play of this character does not appear until adolescence, the games common to an earlier age calling for individual play, or the competitive element, or the homogeneous social characteristics of the folk games. The training of the will is another strong educational feature of games. The timid, hesitating child, who at first shrinks from exposed positions or an aggressive part, gains courage and self-reliance; defeat becomes, instead of a discouragement to all effort, a spur to greater; and the inhibitive

control required to obey rules and regulations, especially under strong excitement, touches another of the well springs of character. So, from the first, clumsy, timid efforts of the little child, to the skilful team work of the college athlete, at once aggressive and self-controlled, games afford a means of development and training for body, mind and character. Were any of these results objects of conscious endeavor on the part of the players, the recreative element of games would be lost. But their unique power lies in the fact of this recreation — this objective interest which holds the attention involuntarily and renders the training incidental, unconscious and natural. Because of this psychological distinction, the expression "gymnastic games," which is frequently heard, is a contradiction in terms and a misnomer. A mistake also is an occasional tendency to discard gymnastic exercise in favor of games, and *vice versa*. While each is an important part of physical training, psychologically and physically there are essential differences between the two forms of exercise. Gymnastics are taken for the purpose of bodily development, and the mind is continually in the unnatural attitude of consciously directing the automatic processes of muscular co-ordination; games are played for the frolic or the victory, without subjective or utilitarian end. This psychological difference is exactly that between work and play. Physically, gymnastic exercise may be more closely adapted to individual powers and needs than the exercise of games; it can afford more vigorous exercise in a brief time to large numbers in limited space; and it is corrective of posture — of faulty neuro-muscular habits. Games, on the other hand, offer a more natural form of exercise, have a larger emotional content, and in their social and psychological training are not approached by gymnastics.

The recreative element in games, the sheer fun and frolic spirit, and the engrossing interest that springs from primitive instincts, cannot be too highly valued as a relief from the pressure which modern civilization brings to bear upon both children and adults. Especially under city conditions should this be fostered. The paucity of childish play and normal youthful sport in cities, owing to lack of space, is not only pitiable, but tragic in view of all that it may mean for the healthful, balanced development and life of the individual. The growth of indoor games as basket ball and indoor baseball, is admirable because making a virtue of necessity; but the movement to provide playgrounds is still better, for gangs of youthful criminals and depredators are found to melt away before them, and the play and games which they foster belong by inherent right to the open sky and the free air. See BASEBALL; BASKET BALL; FOOT-BALL; FOLK-LORE; HOCKEY, ETC.

JESSIE H. BANCROFT,
Director Physical Training, Public Schools, Brooklyn, N. Y.

Bibliography.— Berenson, etc., 'Basket Ball for Women' (1893); Bigelow, etc., 'One Hundred and Fifty Gymnastic Games' (1902); Bolton, 'The Counting-Out Rhymes of Children' (1888); Boykin, 'Physical Training,' report of the United States Commissioner of Education (1891–2); Chamberlain, 'The Child: A Study in the Evolution of Man' (1900); Culin, 'Street Games of Brooklyn,' 'Journal of American Folklore' (Vol. IV. 1891); 'American Indian Games' Ibid. (Vol. XI. 1898); 'The Value of Games in Ethnology,' Proceedings American Association for the Advancement of Science (1894); De Coubertin, 'The Olympic Games of 1896,' 'Century Magazine,' (November 1896); Fielde, 'A Corner of Cathay' (for games of Chinese children) (1894); Gomme, 'Traditional Games,' 'Dictionary of British Folk Lore' (1894); 'The International Games of England, Scotland, and Ireland, with Tunes, Singing Rhymes, and Methods of Playing' (1894–8); Gross, 'The Play of Animals' (1898); 'The Play of Man' (1901); Gulick, 'Psychological, Pedagogical, and Religious Aspects of Group Games,' Pedagogical Seminary, March 1899; 'Some Psychical Aspects of Muscular Exercise,' 'Popular Science Monthly' (1898); Hartwell, 'Physical Training,' United Sates Bureau of Education (1899); Johnson, 'Education by Plays and Games,' 'Pedagogical Seminary' (Vol. III. 1894); 'Play in Physical Education,' 'Report of the National Education Association' (page 948, 1898); Lee, 'Playground Education,' 'Educational Review' (December 1901); Monroe, 'Play Interests of Children,' 'Report of the National Educational Association' (1899); Newell, 'Games and Songs of American Children' (1884); Plummer, 'Athletics and Games of the Ancient Greeks,' 'American Physical Education Review' (1898); Tsanoff, 'Educational Value of the Children's Playgrounds' (1897).

Gammer Gurton's Needle, a drama by John Still, supposed to have been the first play acted at an English university, is also one of the two or three earliest comedies in our language. In 1575, nine years after it was staged at Christ's College, Cambridge, it made its appearance in print. The plot is very simple. Broad jokes, extravagant language, and situations depending for their fun on the discomfiture of one or another of the actors, gave this play great popularity in its day. Readers of the present time who penetrate behind its quaint and uncouth language will find in it an interesting picture of 16th-century village life.

Gamp, MRS. **Sairey,** in Dickens' 'Martin Chuzzlewit' (1843–4), a stout and elderly professional nurse with a watery eye and a fondness for spirits. She is loquacious and confidential, and continually refers to the opinions of a fabulous being, "my friend Mrs. Harris." Her amorphous umbrella has furnished the name "gamp" for that type of impedimenta.

Gamtoos (găm'tōs) **River,** Cape Colony, South Africa, which rises in the plateau of Great Karoo and empties into the Indian Ocean.

Gam'ut (Italian, *gamma;* French, *gamme*), the name given in the system of Guido d'Arezzo to the entire series of musical tones in the natural order of ascent or descent. The musicians of the 11th century made use, to distinguish a succession of tones of several octaves, of the following scale: *A, B, C, D, E, F, G, a, b, c, d, f, g, aa, bb, cc,* etc. *A* represented the lowest note in their instruments; a lower note having been introduced the Greek gamma (Γ) was taken to represent it in order not to repeat any of the previous signs. The gamma being thus the first note of the scale, its name was taken to represent the whole. The *ut* is the

first word of a Latin hymn formerly used in singing the scale.

Gananoque, gä-nä-nōk', Ontario, Can., a port of entry of Leeds County, 18 miles northeast of Kingston, on the St. Lawrence River, at the point where it flows from Lake Ontario. It is opposite the Thousand Islands, and has long been popular as a summer resort. It has a fine insular public park, and manufactures machinery and farming implements. Pop. (1901) 3,526.

Gándara, gän'dä-rä, Philippines, a pueblo of the island of Samar, situated in the western part of the island on the left bank of the Bachao Bañgahón River. In 1900 it was almost entirely destroyed during an engagement with insurgents; before that it had a large trade. A United States military station and depot for stores is situated eight miles by river from Gándara. Pop. 15,600.

Gando, gän'dō, Africa, a kingdom of the western Sudan, intersected by the Niger, and inhabited chiefly by Fellatahs, with a capital of the same name. It is a most fertile district, the rain being plentiful. Mohammedanism is the prevalent religion. Gando is now comprised partly in British and partly in French territory. Pop. estimated at 5,000,000.

Ganges, gān'jēz, one of the greatest rivers of Asia, and "the sacred river of the Hindus," rises in the Himalaya Mountains, in the province of Garhwal, northern India. It is formed by the junction of two head streams, respectively called the Bhagirathi and the Alaknanda, which unite at Deoprayag, 10 miles below Srinagar, 1,500 feet above the level of the sea. The Bhagirathi which flows from an ice cave in a snow field, 13,800 feet above sea-level, is usually considered the source of the Ganges from its being a sacred stream in Hindu mythology; but the material claims of the Alaknanda are preferable, as it flows farther and brings a larger volume of water to the junction. At Hardwar, about 30 miles below the junction of the head streams, and about 120 miles north-northeast of Delhi, the river is only 1,000 feet above sea-level. Here it enters the great valley-plain of Hindustan, and flows in a southeast by south direction until it discharges itself by numerous mouths into the Bay of Bengal, a distance exclusive of windings of fully 1,100 miles. Its length, with deviations, is calculated at about 1,500 miles. During its course it is joined by a number of large rivers, the principal of which are the Jumna and Son, joining on the right bank; the Ramganga, Gumti, Gogra, Gandak, and Kusi, on the left bank. Some of the principal cities on the Ganges and its branches, descending the stream, are Cawnpore, Allahabad, Benares, Patna, Behar, Murshidabad, and Calcutta. The Ganges is navigable for boats of large size nearly 1,300 miles from its mouths. It is a great feeder of irrigation and navigation canals. (See GANGES CANAL.) Its utmost breadth is about three miles, with a maximum depth of about 30 feet in the dry season, and 60 feet in the wet. Its descent is computed at four inches per mile; its current in the dry season is less than three miles an hour; in the wet season five or six. The quantity of water discharged into the ocean is estimated at 500,000 cubic feet per second during the flood season, and 100,000 during the remaining eight months of the year. Its current brings down a great quantity of mud, which in the course of ages has contributed to form the wide delta which belongs to it in common with the Brahmaputra. The delta, intersected by numerous branches, extends from east to west from 80 to 200 miles, and commences about 200 miles, or 300 by the course of the river, from the sea. A part of it is an uninhabited region called the Sundarbans, overgrown by jungle, infested with tigers and crocodiles. The westernmost deltaic branch of the Ganges called the Hugli, is the only branch commonly navigated by ships; and vessels drawing 26 feet are safely piloted up to Calcutta; the construction of embankments, and continuous dredging, are necessary to keep a clear channel. The Ganges, as the Padna, continues eastward until it joins the Jamuna, the main branch of the Brahmaputra, which flows through the estuary of the Megna, the deltaic boundary on the east, into the Bay of Bengal. The periodical inundation of the Ganges commences about the end of April with the tropical rains. It rises gradually till it attains, near the commencement of the delta, a height of 32 feet above its ordinary level. By the end of July, the flat country of Bengal is overflowed to the extent of 100 miles in breadth, leaving visible little but tops of trees and villages, which are often built on artificial mounds above flood mark. After the middle of August the water begins to recede, and decreases till the period of the next inundation.

That part of the Ganges which lies between Gangotri, the first temple and pilgrim resort on its banks, 10 miles from its source, and Saugor Island, below Calcutta, is held particularly sacred. Wherever the river runs from south to north contrary to its usual direction, and at the junction of its affluents, it acquires a more peculiar sanctity. Its junction with the Jumna at Allahabad (q.v.) forms the most venerated place of Hindu ablution. The Hindus believe that this river rises immediately from the feet of Brahma, and that it possesses great and miraculous cleansing powers on account of its divine origin. There is a scientific basis for this universal faith among Hindus, repeated and careful experiments showing that the river possesses extraordinary but hitherto inexplicable antiseptic qualities.

It is an imperative duty of the Hindus to bathe in the Ganges, or at least to wash themselves with its waters, and to distribute alms, on certain days. Whoever dies on its banks, and drinks of its waters before his death, is thought to be exempted from the necessity of returning into this world and commencing a new life. Whenever, therefore, a sick person has been given over by the physicians, his relations hasten to carry him to the bank of the Ganges, in order that he may drink of the holy water, or be immersed in the river. Such as live too far from the river to admit of this, always preserve some of the precious water, as a sacred treasure, in a copper vessel, that it may be given them in the hour of death. This water is, therefore, a considerable article of commerce in India. It is also customary, after the dead have been burned, to preserve the remains of the bones and the ashes until an opportunity offers of throwing them into the Ganges.

The name Ganges is derived from *gam*, a Hindu verb signifying "to go." In Hindu mythology the river is personified as the goddess Gangā.

Ganges Canal, The, in India, an important irrigation work and navigable channel, the older portion called the Upper Ganges canal, opened in 1854, and extending, on the right of the Ganges (q.v.) from Hardwar to Cawnpore and Etawah, with a main canal 440 miles long, navigable throughout; and with 2,634 miles of distributaries. The Cawnpore and Etawah terminal lines are now absorbed in the Lower Ganges canal, commenced in 1873, and which continues in its main branch for 260 miles to Allahabad, drawing its supply from the river at Narora, in the Aligarh district. The weir and headworks at Narora include a solid wall, 3,800 feet long, with 42 weir sluices, founded on huge square blocks.

Gan'glion, connective tissue membranes enclosing small amounts of clear synovial fluids. They are usually found where tendons or muscles glide over bony parts, or where the skin, muscles, or fascia are subjected to pressure or to friction. The number, size, and location of these structures are subject to much individual variation. One of the commonest is found on the back of the hand, at the wrist, particularly in people who stretch their fingers widely, as piano players, or as librarians who handle many books, grasping several at a time. In this form is a firm and painless swelling, liable to be caused by any excessive exercise of the wrist, as in playing tennis, golf, etc. This swelling gives the impression that there is fluid beneath the skin, and grandmother's advice to break it with the family Bible or the dictionary is often followed, sometimes with serious results. This forceful method of reduction is foolish, as most of the swellings disappear with rest and the application of heat. If they persist, a surgeon should be consulted. Another very persistent variety of this trouble is found in the knee — causing housemaid's knee, or miner's knee. Obviously the breaking of these tumors by force is out of the question. There are many places in the body in which similar collections of fluid may accumulate, but these rarely cause much inconvenience unless they become infected through some knock or cut. In this event prompt surgical treatment is advisable, and aseptic surgery should be insisted on. A careless and unclean surgeon may render a limb useless.

Gangotri, gän-gō'trē, a square temple, about 20 feet high, erected on the right bank of the Ganges (q.v.), which here forms a small bay, about 10,319 feet above the level of the sea. This spot is regarded by pilgrims as the source of the holy stream, here called the Bhagirathi, which, however, rises 8 miles higher up. The water here is peculiarly sacred, but few pilgrims come so far, and the only dwelling-house in the locality is occupied by the officiating Brahmins, by whom flasks of the holy element are sealed for conveyance to the plains.

Gangrene, găn'grēn, the term applied to death of soft tissue in masses large enough to be seen. There are two forms, differing in causation, appearance, and progress. Dry or senile gangrene results from the gradual occlusion of arteries, the venous return being unimpaired. For weeks or months the toes and feet, the parts most frequently affected, may feel cold or numb, or be actually painful, then gradually the skin becomes dry, then purple and black. The spread is usually very slow. It is particularly a disease of old age, due to the tendency at that period of life toward thickening and stiffening of the arterial walls.

Moist gangrene results from sudden stoppage of the arteries, obstruction of veins, mechanical destruction of the tissues, or from specific infection by germs. This form shows a soft, boggy, bluish mass covered with blisters and emitting the odor of putrefaction. In both forms of gangrene there may be a zone of inflammation between the dead and the living tissue, called the line of demarcation.

Hospital gangrene was formerly very prevalent in military hospitals; a wound becoming infected would quickly change to a gray slough, which in a few hours might involve the entire limb unless prompt removal of the tissue was undertaken. Aseptic surgery has made this fatal disease a thing of the past.

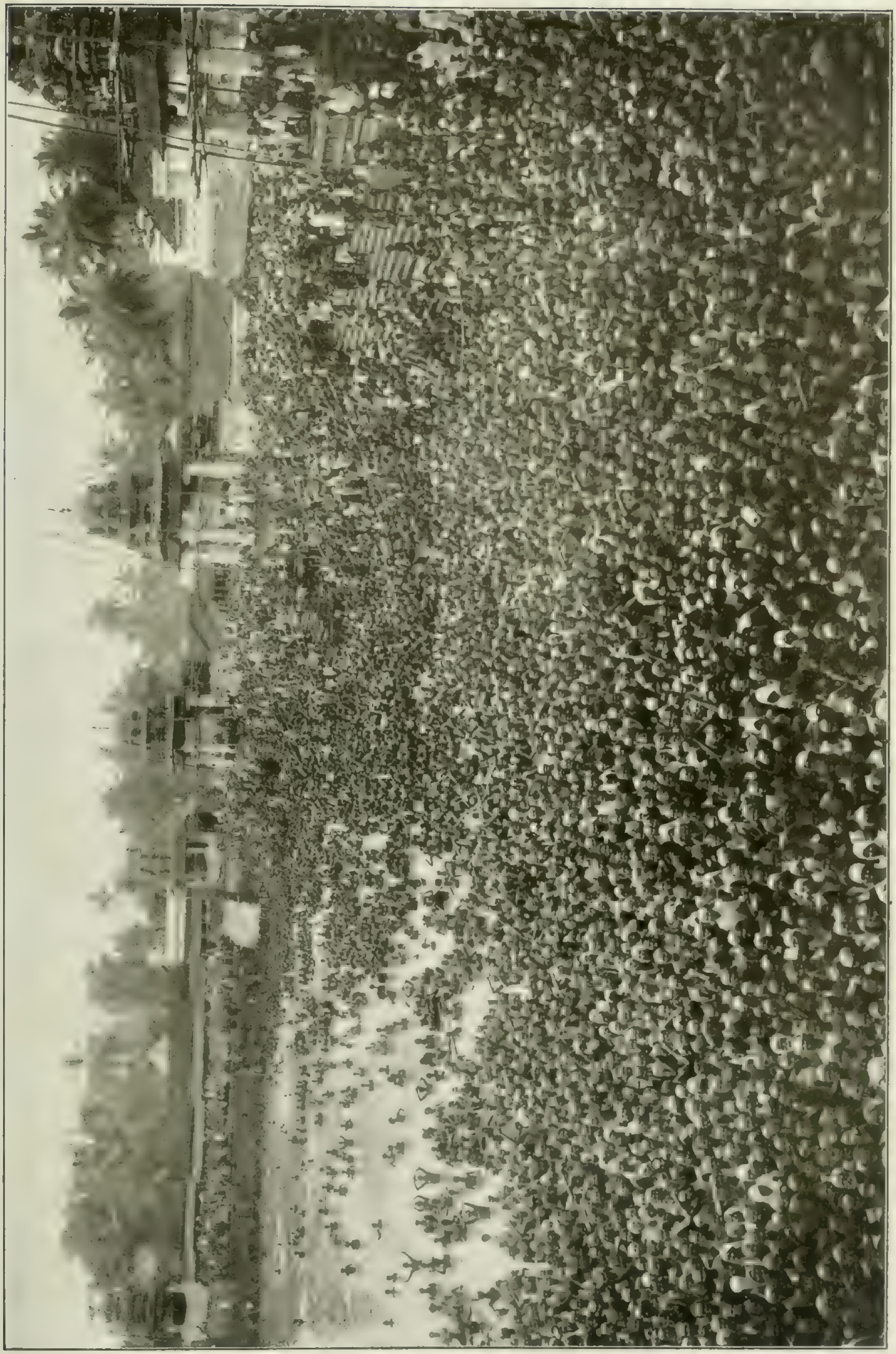
Spreading gangrene is due to infection by a specific germ, the bacillus of malignant œdema, so called from the fact that it generates a gas that puffs up the tissue affected. The spread is rapid, and life is sometimes saved by amputation far above the wound. The treatment of gangrene is usually a matter of amputation, well beyond the affected part. Careful aseptic dressing is imperative, particularly where the condition of the patient is apt to contra-indicate radical cure.

Gangue, găng (Ger. *Gang*, a vein), the matrix or veinstone of ores. These are always included in some stony matter, which forms the principal portion of the veins or beds which are worked for the sake of their metalliferous contents. Quartz is the most common veinstone, and has been called the mother of ores. Calcareous spar is also a frequent predominant material of veins. Sulphate of barytes or heavy spar, and fluor spar, are also often found as gangues.

Gan'ister, a name originally given in England to a particular clay high in silica, used in the manufacture of fire-brick. In this country the term is used more loosely and includes non-plastic rocks that are not clays at all but approach sandstones in character. Ganister may, therefore, be defined as highly silicious material used in the manufacture of fire-brick, more particularly what are known as silica-brick, for lining blast-furnaces, Bessemer converters, etc. The manufacture of such brick is an important industry in Western Pennsylvania. See CLAY.

Gannal, gä-näl, **Jean Nicolas,** French chemist: b. Saarlouis, Prussia, 28 July 1791; d. Paris January 1852. He is noted for his invention of the method of embalming by injection.

Gannets, large sea-birds constituting the family *Sulidæ*, of the order *Steganopodes*, characterized by having all the toes connected by webs, the absence of external nostrils and a very short tongue. They are closely related to the pelicans and cormorants, have large powerful bills and feed upon fish, frequenting the sea-coasts of various parts of the world. The common gannet



BATHING IN THE GANGES.

(*Sula bassana*), to which the name properly refers, is restricted in the breeding season to a few rocky islets on the coast of the British Isles and Iceland — notably the St. Kilda group, and to Bird Rock in the Gulf of St. Lawrence; and their numbers have been much diminished by the fishermen who gather their eggs for food. They nest in colonies among the crevices and ledges of the rocks, and each bird lays a single large chalky white egg. When the young are on the wing they all leave together and scatter widely in search of food, extending their range on our coasts as far as the Gulf of Mexico. In the southern hemisphere are two closely related gannets. *S. serrator* of Australia and *S. capensis* of South Africa. Eight other somewhat smaller species, called «boobies» (q.v.), breed on various tropical islands. The common gannet is pure white with black outer wing-feathers and a buffy suffusion on the head. The young are mottled grayish brown. The other species are similar, many of them with red and blue coloring on the bare skin of the throat and around the eye.

Gan'nett, Ezra Stiles, American Unitarian clergyman: b. Cambridge, Mass., 4 May 1801; d. near Boston 25 June 1871. He was graduated from Harvard in 1820, in 1824 became assistant to W. E. Channing at the Federal Street Church, Boston, and later succeeded to the pastorate. In the Unitarian controversies of 1825–35 he took a prominent though conservative part. He was the first secretary of the American Unitarian Association, its president 1847–51, and president of the Benevolent Fraternity of Churches 1857-62. He was also founder and editor of the 'Scriptural Interpreter,' and an editor of the 'Christian Examiner,' and the 'Monthly Miscellany of Religion and Letters.'

Gannett, Henry, American geographer: b. Bath, Maine, 24 Aug. 1846. He was graduated at the Lawrence Scientific School in 1869; became geographer of the United States Geological Survey in 1882; was geographer of the 10th, 11th, and 12th censuses, and of those taken by the war department in Cuba and Porto Rico in 1899. His publications include: 'Manual of Topographic Surveying'; 'Statistical Atlases 10th and 11th Censuses'; 'Dictionary of Altitudes'; 'Commercial Geography'; etc.

Gannett, William Channing, American Unitarian clergyman: b. Boston, Mass., 1840. He is a son of E. S. Gannett (q.v.). He has held Unitarian pastorates at St. Paul, Minn., and other cities, and has been for some years pastor at Rochester, N. Y. He is the author of: 'A Year of Miracle'; 'Memoir of Ezra Stiles Gannett'; 'The Thought of God in Hymns and Poems' (with F. L. Hosmer).

Ganodonta, a group of primitive mammals regarded as ancestral to the edentates, whose remains are found in the lowest Eocene formations of the western United States. These remains are not numerous nor complete, but plainly exhibit a progressive relationship toward modern Edentata (q.v.). The earliest known is *Hemiganus,* from the Puerco beds of New Mexico, which was as big as a medium-sized dog. A later genus of similar size is *Psittacotherium;* and a still later (Lower and Middle Eocene) is *Stylinodon.* In reviewing the series, says Beddard, we see a gradual diminution of the incisors, a gradual loss of enamel on the teeth generally, and the production of hypsilodont teeth growing from persistent pulps, all of which are features of the later edentates. The progression is gradual, but the forms seem to be a continuous series culminating in the ground-sloths. See PALÆONTOLOGY.

Gan'oid Fishes, an order of fishes founded by Agassiz on the character of the scales of certain fossil fishes, which are bony and lustrous, now regarded as a group-name for a rather heterogeneous series of low and chiefly extinct teleost or «true» fishes. (See ICHTHYOLOGY.) The ganoids were most numerous in Palæozoic and early Mesozoic times, and few and diverse are the surviving forms, which include the paddle-fishes and sturgeons, the gar-pikes, the mud-fishes of African rivers and a few others, all elsewhere described. In this group fall some of the most famous fossil fishes of palæontology, described by Hugh Miller in his 'Old Red Sandstone' and otherwise introduced long ago to the public. The *Pteraspis* and *Cephalaspis* of the Upper Silurian and Lower Old Red Sandstone strata had the head covered with a bony shield, which in form somewhat resembled the carapace of some crustaceans; the body of *Cephalaspis* had bony scales. The berry-bone (*Coccosteus*), the seraphim (*Pterichthys*), and the *Asterolepis* also had a bony shield, the flexible trunk having scales in *Pterichthys,* being naked in *Coccosteus.* The anterior limbs, or pectoral fins, of *Pterichthys* were long, covered with closely fitted plates, and had a complex joint connecting them with the thorax. The garpikes of the American lake region, are the modern representatives of the *Lepidotus, Æchmodus,* etc., of Mesozoic strata, and of the Carboniferous *Palæoniscus. Polypterus,* the type of this group, is confined to the Nile, and a few other African rivers. The group is most abundant in the Palæozoic strata, *Dipterus, Osteolepis, Holoptychius, Phaneropleuron,* being Old Red Sandstone genera; *Rhizodus, Megalichthys* with rhomboidal scales, *Strepsodus* with cycloid scales, Carboniferous. The cœlacanths range from the Carboniferous to the Chalk formations, and are the only members of the order in which the tail is homocercal.

Gansevoort, găns'voort, **Peter,** American officer: b. Albany 17 July 1749; d. 2 July 1812. In 1775 he joined the army which under Montgomery invaded Canada, and in 1776 he was appointed to the command of Fort George. In 1777 he was placed in command of Fort Stanwix, which he gallantly defended against a vigorous siege of 20 days by British and Indians under St. Leger, and received the thanks of Congress for having thereby prevented the co-operation of that general with Burgoyne, and contributed to the defeat of the latter. In 1781 the State of New York raised him to the rank of brigadier-general, which he held till the termination of the war. He afterward filled various important offices under the Federal government. He was successively commissioner of Indian affairs, commissioner for fortifying the frontiers, and military agent. In 1809 he was appointed brigadier-general in the United States army.

Gan'ymede (Gk. Γανυμήδης; Lat. *Ganymedes*), in Greek mythology the son of Tros and of Callirrhoë, a daughter of the Scamander. Zeus sent his eagle from heaven, which carried

him off from Mount Ida to the seat of the gods, where he discharged the office of cup-bearer to the immortals, Hebe having rendered herself unworthy of this office. This fiction has afforded, both to poets and artists, an inexhaustible supply of subjects. Numerous paintings, statues, cameos, and intaglios, masterpieces of ancient art, have descended to us, upon which this youth, scarcely past the years of boyhood, is represented as of great beauty. The representations of Ganymede are to be recognized by the Phrygian cap and the eagle, which is either standing beside him or carrying him in its talons to Olympus.

Gapán, gä-pän′, Philippines, a pueblo of the province of Nueva Ecija, Luzon, situated four miles east of San Isidro, the capital. It is at the junction of several roads, and is the largest town in the province. Pop. 20,200.

Gaper, ga′- or gā′per, a name given to many animals who have great mouths, or in some other way suggest gaping. Thus it is one of the British names for the European soft clam (*Mya truncata*) in reference to the wide separation of the shells, as is characteristic of deeply burrowing bivalves; and it is applied to relatives on the Pacific coast of the United States. Among birds, the broadmouths (q.v.) are called gapers; and among fishes some of the sea-bass, which open their mouths in dying to the widest extent.

Gapes, a disease of young poultry, caused by a parasitic nematode worm in the throat. See POULTRY, DISEASES OF.

Gar, Garfish, or **Gar-pike**, one of two sorts of fish, both long and slender, with a prolonged spear-like snout filled with teeth, and hence bearing such local names as "bill-fish," "needle-fish," "bony-pike," etc.; and "green-bone," because of the greenish tinge on the bones. The group originally called "gar" was that of the family *Belonidæ* (or *Esocidæ*), allied to the sauries and flying-fish, the type of which is the common European *Belone belone*. This is a swift, voracious fish which darts along the surface picking up little fishes, and especially playing havoc in shoals of young mackerel. It is usually about two feet in length, is often brought to the London market, and forms a wholesome dish, in flavor somewhat like mackerel. The young forms have at first jaws of a normal size, but in growth the lower outstrips the upper. Very similar, but larger, are the "silver" gars, "agujas," or "needle-fish" of American tropical waters, which offer good sport by their speed and strength, but are hated by practical fishermen whose nets they frequently destroy or damage by their effort to get at imprisoned prey. There are several species, all of the genus *Tylosurus*.

Both these kinds, as well as their Oriental representatives, are often called "gar-pikes" from their pike-like form and voracity; but in the United States this term is suitably reserved for a very different kind of gar, not known in the Old World, and a relic of the ganoid tribe prevalent in the palæozoic seas. This gar-pike represents the family *Lepidosteidæ* (see ICHTHYOLOGY), and has a long almost cylindrical body encased in an armor of white, bony, enameled rhomboid plates, which are imbricated in oblique rows running downward and backward. The jaws are long, narrow, and furnished with sharp teeth, each of which fits into a depression in the opposite jaw; and are covered with a granulated shagreen-like integument. They have the air-bladder subdivided and used in respiration; no spiracle; strong fins; a heterocercal tail; swim well, and prey upon small fishes. Their own flesh is not edible and they interfere with fishing, and therefore are destroyed freely. They inhabit the rivers and lakes of North America, where the commonest species is the long-nosed gar (*Lepidosteus osseus*). Another, more southerly, is the short-nosed gar (*L. platystomus*); and a great and powerful subtropical species (*L. tristœchus*), reaching 8 or 10 feet in length, and called "manjuari" in the West Indies, is known as "alligator-gar" in the lower Mississippi district. Another species occurs on the west coast of Central America; and another in the rivers of China.

All these gar-pikes frequent shallow, reedy, or grassy places, basking in the sun like the pike, and devouring living prey with great voracity. The manner of seizing prey differs from that usually observed in fishes, and resembles that of reptiles; instead of taking their food at once with open mouth and swallowing it immediately, they approach it slily and sideways, and then, suddenly seizing the fish or other animal, hold it until by a series of movements it is placed in a proper position for being swallowed, in the manner of alligators and lizards; the ball of food is also seen to distend the body as it passes downward, as in snakes.

Gar-pike. See GAR.

Garabit, gä-rä-bē, France, in the department of Lozère, is a picturesque locality on the railway from Marvejols to Neussargues, where the line spans a gorge of the Truyère River, about 10 miles south of Saint Flour. The viaduct planned by M. Eiffel is 1,852½ feet long, and is built partly of girders and partly of masonry. Where it crosses the river at a height of 401 feet, it is supported by an arch, with a span of 541 feet 4 inches. Consult: Eiffel, 'Le Viaduc de Garabit' (1889).

Garancine, găr′an-sĭn, is prepared from the ground root of *Rubia tinctorum* or madder (in French *garance*) by washing it with 8 or 10 times its weight of water acidulated with sulphuric acid, 1 part of acid being used for 100 parts of powder. After digesting for 7 or 8 hours the fluid is run off, and the paste is boiled for 2 or 3 hours by steam with more acid, and then the mass is thrown into cold water contained in a large trough with a perforated bottom covered with cloth to act as a filter. Here it is washed till all the acid is got rid of, and the paste is afterward pressed, dried, and ground to fine powder. It is used for dyeing, and has the advantage over madder (q.v.) of containing a large proportion of coloring matter. It is preferable to madder for mixing with other dyestuffs to produce chocolate and some other shades.

Garay, Juan de, hoo-än′ dā gä-rī′, Spanish soldier: b. Badajoz 1541; d. South America 1584. About 1565 he went to South America, where he became secretary to the governor of Paraguay, was sent on a voyage up the Paraná, discovered a vast territory, and founded near the river the town of Santa Fé de Vera Cruz. He

defeated the Charruas Indians not far from the Uruguay, received the commission of lieutenant-general, and was appointed (1576) governor of Asuncion. In 1580 he re-founded the city of Buenos Ayres on its previous site, and subsequently did much to improve the condition of neighboring native tribes. Having landed in an unfamiliar region on a journey up the Paraná to Asuncion, he was there killed by hostiles.

Garbage is kitchen refuse and table waste, offal, or discarded material from the preparation and use of human food. Assembled, it is an ever-varying mixture of animal and vegetable food waste, the nitrogenous or proteids being largely in excess of the non-nitrogenous properties. Garbage decomposes rapidly in the open air and becomes offensive, especially in warm weather. When thrown upon the ground and allowed to decompose, or when used as a fertilizer in a raw state, it may contaminate sources of water supply, and thus become a menace to public health. In country districts and in most towns and small cities it is used as food for domestic animals, and when fresh no more proper disposition of it can be made. When the material is allowed to become partially decomposed before feeding, and where caustic solutions are used for the cleansing of cooking utensils, etc., the mortality caused thereby, particularly among hogs, is so serious as to preclude its use. American cities produce from one half pound to one pound per day for each person. European cities produce less than one half of this amount for each person. Analysis of American city garbage shows moisture 70 per cent to 80 per cent; grease, 2 per cent to 3 per cent; and solids, principally wood fibre, 18 per cent to 28 per cent. Garbage from European cities contains more of solids and less of moisture and grease.

Compared with the garbage of New York city, British garbage contains about 25 per cent and German about 50 per cent less water. Practically, France has no garbage.

No other problem so far encountered has so troubled city officials and boards of health as the disposal of garbage. The thoughtless citizen throws it in the street, or leaves it in his back yard until his neighbors rebel, or he burns it in his range or furnace and has more trouble with his neighbors. He puts it with ashes and other refuse and it is dumped on a vacant lot, or a depression in the ground is filled with it, and injunction proceedings are brought by near-by residents; protests and complaints of every description are made to councilmen, heads of departments, and boards of health. Newspapers take it up, and everyone who can possibly be held accountable is abused. The first attempts at collection and disposal are crude and imperfect. All kinds of household wastes are put together in boxes or barrels and teams are hired to cart it away. In some cases the city owns the horses and wagons required for the work. This lasts until there is no longer a dumping place within hauling distance. In a few instances it has been taken to sea in scows and dumped in deep water. This is found objectionable, as the lighter portions float to shore. Total destruction of the material is the next resort. Inventors and promoters take advantage of the situation, and it is proposed to burn or utilize the material at huge profit. Corporations are formed, stock is sold, and plants are built for final disposal. Then there are indignation meetings and injunction proceedings. No one wants a garbage-disposal plant near his property. Should it be completed and started, it is generally closed within a year, either by injunction or owing to the lack of funds for its operation. The country is strewn with such wrecks. From one to a half dozen can be found in almost every city. Many are so utterly worthless in practice as to approach very nearly to the ridiculous. Others are admirable in design and construction, but fail on account of insufficient returns or excessive cost of operation. Much has been learned, however, through these failures.

It has been found that when garbage is mixed with ashes, paper, and other household waste, final disposal is rendered very difficult, the mass being unfit for filling, fuel, or fertilizer. Leading American cities separate household waste into three parts, namely, "food waste," "combustible waste," and "non-combustible waste." By this means final disposal is more readily effected, each class of waste having properties of commercial value when kept separate from the others. Most European cities do not attempt a separation, excepting it be at the plant where final disposal is effected. In some cases the whole mass is passed through what are termed "destructors," burning the unconsumed carbon found in the ashes, and the combustible portions of other household waste. This system of final disposal has not been found satisfactory in American cities, and has been equally unsatisfactory in some European cities, particularly on the Continent, where, as in America, it is found that much additional fuel is required in order to maintain a proper temperature in the furnaces. Many of them have, therefore, been abandoned altogether, and attention has been turned to some form of utilization as being more reliable and less expensive.

Engineers have struggled manfully with the problem, and have been ably seconded by men of means and energy. It would scarcely be possible to name in this connection all those who have contributed to the development of principles, systems, and apparatus which go far toward the practical solution of this difficult problem. Much impetus was given to effective practical development of the principle of utilization by the determined efforts of the late Col. Geo. E. Waring, New York's indomitable commissioner of streets. After a most exhaustive investigation of the whole subject, and a thorough inspection and test of every system of disposal then in existence, both in Europe and America, Col. Waring became thoroughly convinced that utilization was right in principle and practice, and proceeded at once to have the garbage of the city of New York disposed of in this manner.

Prior to this time there were successful utilization plants in Philadelphia, Pa., St. Louis, Mo., and Detroit, Mich. The system adopted by Col. Waring, and which is now in use in many of the principal cities of the United States, is first, thorough sterilization by subjecting the material to the action of live steam in enclosed vessels, condensing all vapors and passing insoluble gas through flame. By this treatment the structure of the material is broken

down,— even bones are disintegrated,— the liquids carrying the oils and greases being separated from the solids by mechanical means. The further preparation of the ingredients, by which they are put in commercial form or finally disposed of, varies greatly in the different plants. In some cases the liquids are evaporated, in others they are allowed to run into sewers or water courses. In a number of the plants the solid portions are used for fuel; in others they are acidulated or dried and prepared as a base for commercial fertilizers. The greases are sometimes extracted by the use of a solvent, and reclaimed by evaporation, the solvent vapors being condensed and also reclaimed to be used again. The principles involved are not new, having been applied for many years to the treatment of slaughter-house waste. In its application, however, to the greater subject of garbage disposal, much new apparatus has been invented, and the plants have been equipped to handle very promptly a vast amount of the material; the plant which disposes of the entire garbage of the Greater New York having a daily capacity of more than 2,000 tons, and the plants located in Philadelphia, Pa., Boston, Mass., Newark, N. J., Baltimore, Md., Washington, D. C., Detroit, Mich., St. Louis, Mo., Cleveland, O., and in some of the smaller cities, are of sufficient capacity to dispose of all the garbage produced in the respective cities within 12 hours of delivery at the plant. It is this prompt and effective disposal that has rendered the utilization systems so popular in the large American cities. The entire work of collection and disposal is, in most cases, done by contract. The plants are owned by contractors, the cities in some cases collecting the garbage and delivering it upon the contractors' cars or boats for transportation to the place of final disposal. The contractors have expended vast amounts of money in perfecting the systems, and certain features, processes, etc., are kept secret. As they are private enterprises, no statement can be made as to returns from the sale of the products, but it is known that reasonable dividends are paid, and that the contracting companies are in a sound condition financially, while the citizen who notes carefully the service rendered is well satisfied with the results.

The state of the art as to final disposal would seem to preclude the utilization systems in cities having a population of less than 50,000, excepting where a combination plant can be used, thus disposing at one plant of all garbage, dead animals, slaughter-house waste, butchers' scrap, etc. Where this cannot be effected, it has been found that burning is the only safe and effectual means of disposal.

Many of the failures, both in incineration and utilization, are due to the improper location of plants. While it should be perfectly clear to everyone that such plants should be so located as to cause the least possible property loss or inconvenience to the people, yet it should be recognized that every city must have a place for final disposal of its waste, and, once properly located, it must be recognized as such. Though plants for final disposal, when properly designed and operated, have not proved a nuisance to near-by residents, nor a menace to public health, yet the assembling at one point of the material is objectionable and should be restricted to a section for such purposes. See Wastes, City, Disposal of.

Much has been written on the subject by both European and American engineers, principally in the form of papers read before some of the engineering societies, and published in engineering journals. Valuable information can be obtained from the files of such journals. Very little of such material, however, has been put in book form. In a small volume published in 1897, entitled, 'Street Cleaning and Its Effects,' by Col. Geo. E. Waring, interesting and valuable data is assembled, a portion of which bears directly on this subject, and in an English publication entitled 'The Economic Disposal of Towns' Refuse,' W. Francis Goodrich gives a very good description of European and American burning methods, with illustrations, plans, and tables well arranged. His data on the subject of utilization is, however, inaccurate and misleading and does not correctly set forth the true state of the art at the present time. A most comprehensive treatise on the subject is 'The Wastes of a Great City' by John McGaw Woodbury, commissioner of street cleaning, New York, in Vol. XXIV., p. 387, 'Scribner's Magazine' (1903).

Charles Edgerton,
President Sanitary Product Company.

Garborg, gär'bôrg, **Anne,** Norwegian novelist: b. island of Time, Jæderen, 25 Jan. 1851. He was educated at Christiania, published anonymously in 1873 his essay, 'Ibsen's "Emperor or Galilean,"' in 1877 founded the 'Fedraheimen,' a liberal journal which he edited until 1882, and in this as well as 'Den syttende Maj,' another periodical, urged the adoption of a national language for Norway. On this subject he wrote also: 'The New Norwegian Language and the National Movement' (1887). His best-known work was done in his stories, originally written in the popular tongue and largely rendered into Swedish and Danish. They are of the realistic vein so common to Scandinavian writers, and include: 'A Freethinker' (serially in 'Fedraheimen' (1878); 'Men' (1886); 'Weary Souls' (1891); 'Fred' (1893).

Garção, Pedro Antonio Correa, pā'drō äntō'nē-ō kōr-rā'ä gär-säṅ', Portuguese poet: **b.** Lisbon 29 April 1724; d. there 10 Nov. 1772. As a lyric poet he stands very high; while his satires, odes, and epistles,— upon the models of Horace,— are dainty and spiritual. He also wrote successful dramas. The Portuguese esteem him for the perfection with which he employed their language in his works. The 'Hymn to Dido' is one of his most popular productions. He was arrested for a personal satire, and died in prison after a long captivity.

Garcia, Diogo, dē-ō'gō gär-sē'ä, Portuguese navigator: b. Lisbon 1471; d. Madrid 1529. In 1526 he sailed with three vessels from Cape Finisterre for South America, in the employ of the company established at La Coruña for the spice trade. He explored the Uruguay (1827), and the Paraná to 27° S., defeated the Indians who had besieged Sebastian Cabot on the latter river, and in 1528 left for Spain. About 1532 he is said to have made a voyage to the East Indies. His account of his Brazilian ex-

plorations appeared in Vol. XV. of the 'Revista do instituto histórico é geográfico do Brasil.'

Garcia, gär-thē'ä, **Manuel del Popolo Vicente,** Spanish vocalist and composer: b. Seville, Spain, 22 Jan. 1775; d. Paris 10 June 1832. After acquiring a considerable reputation as a tenor singer in Cadiz and Madrid, in 1808 he obtained great success at the Italian opera in Paris, and afterward proceeded to Italy, where he was received with equal favor. From 1816 to 1824 he was constantly engaged as a singer, either in Paris or London. In 1825, with a select operatic company, composed in part of members of his own family, he crossed the Atlantic and visited New York and Mexico. On the road between Mexico and Vera Cruz he was robbed of all his money; and after his return to Paris was compelled to open a class for singing, as his voice had become greatly impaired by age and fatigue. Many of Garcia's pupils reached a high degree of excellence, but none equaled his eldest daughter Maria, afterward Madame Malibran (q.v.). He was less successful as a composer, though several of his works, such as 'The Caliph of Bagdad,' were much admired.

Garcia, gär-thē'ä, **Manuel,** Spanish professor of singing in England: b. Madrid, Spain, 17 March 1805. He was a son of the preceding. He invented the laryngoscope, and published: 'Memoire sur la voix humaine' (1840); 'Trâite de la Chant' (1841); 'Hints on Singing'; etc.

Garcia y Iniguez, gär-se' ä ē-nē'gĕs, **Calixto,** Cuban patriot: b. Holguin, Cuba, 14 Oct. 1836; d. Washington, D. C., 11 Dec. 1898. In 1868, with Donato del Marmol and Carlos Manuel Cespedes, he organized the revolution known as the "Ten Years' War." In the early part of the struggle he won the battle of Santa Maria and recaptured Jiguani. In recognition of his services Garcia was appointed brigadier-general under Gomez (q.v.), and subsequently succeeded that officer as commander-in-chief of the Cuban army. In 1873 he was captured and carried as a prisoner to Spain. In 1879 he returned to Cuba to start "The Little War," but was again captured and kept in Spain under police surveillance for 15 years. In 1895 he escaped and came to New York, where he fitted out a filibustering expedition, which failed to reach Cuba on account of the wreck of the vessel. Later he was successful in landing in Cuba with arms and supplies. He was given the command of the forces in Camaguey and Oriente, where he held almost complete possession, and in 1898 gave valuable aid to the American forces at the capture of Santiago. At the close of the Spanish-American war he was made chief of the commission to discuss with President McKinley the future of Cuba.

Garcia Moreno, gär-sē'ä mō-rā'nō, **Gabriel,** Ecuadorean politician: b. Guayaquil, Ecuador, 1821; d. Quito 6 Aug. 1875. He was educated at Quito and in Europe, became professor of chemistry in the University of Quito, and in 1857 its rector. In 1859, upon the overthrow of the Roble's government, he was chosen a member of the provisional government, and in 1861 president for a term of four years. He declared himself dictator in 1864, subsequently relinquished the title and office, though he maintained virtual control of affairs, in 1869 led a revolution, and became again dictator, and in 1875 was elected president for a six-years' term. Before his inauguration he was fatally wounded by assassins.

Garcia de Quevedo, gär-sē'ä dā kā-vā'dō, **José Heriberto,** South American author: b. Coro, Venezuela, March 1819; d. Paris June 1871. Educated in France and Spain, he settled in Paris, and was killed in the communard insurrection of 1871. Among his poems are: 'To Columbus'; 'To Liberty'; 'To Pius IX.'; 'Frenzy'; 'The Life to Come'; and 'The Proscript.' His dramas were well received. He wrote the novels 'The Love of a Girl' and 'Two Duels Eighteen Years Apart.'

Garcilaso de la Vega, gär-thē-lä'sō dā lä vā'gä (properly GARCIAS LASO DE LA VEGA), Spanish poet: b. Toledo 1503; d. Nice 14 Oct. 1536. According to an account given in the 'Historia de las Guerras Civiles,' the Garcilasos received their surname from their combats with Moorish heroes, in the great valley of Granada, called *La Vega*. Garcilaso soon found his proper sphere. His genius was kindled by the study of the ancients, particuarly of the Romans. Boscan had already begun to transplant the versification of the Italians into Spanish poetry. Garcilaso followed his example, and succeeded so well that he is still ranked among the best Spanish poets. Most of the events of his life may be learned from his own works. He lived for a long time in Italy, and afterward traveled through part of Germany, in the service of Charles V. In 1529 he was engaged in the expedition against Soliman, and in 1535 in that against Tunis. In the latter he received a wound in his arm, after which he remained some time in Naples. In 1536 he commanded 30 companies of infantry, and accompanied the imperial army against Marseilles. Spanish poetry is highly indebted to him; for without his aid Boscan, a foreigner, would never have succeeded in his innovations, more particularly as he had a formidable adversary in Christoval de Castillejo. His writings consist of eclogues, epistles, odes, songs, sonnets (in which he imitated Petrarch), and some smaller poems. An edition of his works, with notes, appeared in 1765, and Herrera's commentary (1580), with notes by Azara (1765).

Garcilaso (Garcias Laso) de la Vega, surnamed the INCA, Spanish historian: b. Cuzco, Peru, 1540; d. Spain 1616. He was the son of Garcilaso de la Vega, one of the conquerors of Peru, and Elizabeth Palla, a princess of the race of the incas. His mother taught him the Peruvian language, and is said to have inspired him with the idea of writing the history of his ancestors. His great work on the history of Peru is in two parts: the first bearing the title of 'Historia de las Antiquedades y Conquista de Piru: Primera Parte de los Comentarios Reales que tratan del Origen de los Incas, etc.' (1609); the second being the 'Historia general del Peru' (1616). He wrote also 'Historia de la Florida (1609).

Garcin'ia, so called after Laurent Garcin (d. 1752), a Franco-Oriental traveler, is the botanical name for a genus of guttifers, the typical one of the tribe *Garcinieæ*. It consists of opposite leaved trees, with a yellow resinous

juice, and generally unisexual flowers with four sepals, four petals, many stamens in from one to four bundles, and a 2 to 10-celled ovary with a single seed in each cell. The fruit of *G. mangostana* is the highly-prized mangosteen. The fruits of *G. pedunculata, G. cornea,* and *G. kydiana* are also eaten, but are not greatly valued. The *G. kola* of tropical Africa yield fruit and seeds similar in properties to the kola-nut. *G. cambogia* and other species of the genus furnish Gamboge (q.v.).

Garda, gär'dä, or **Benaco, Lake,** the Italian *Lago di Garda,* and the *Benacus Lacus* of the Romans, is an extensive and beautiful lake in north Italy, 33 miles long from north to south, by 3 to 11 miles broad, and 213 feet above sea-level. It forms part of the boundaries of the provinces of Verona, Mantua, and Brescia, while its north extremity enters the Austrian territory of Trent, in the Tyrol. It receives the Sarca, almost its only affluent, at its north end, and is drained by the Mincio, which issues from its southeast end near the fortress of Peschiera, and conveys its waters to the Po. Storms are not infrequent, and are sometimes violent: It is well stocked with excellent fish including salmon-trout, trout, eels, and pike. Garda is the largest lake in Italy, and attains a depth of over 1,000 feet in many places. Its shores are covered with villas and steamboats ply on it regularly between the ports of Riva, Desenzano, and Peschiera, which with Gardone-Riviera, Garda, Malcesine Salo, and the beautiful promontory of Sirmione are its most popular resorts.

Garde Nationale, gärd nä-sē-o-näl, a guard of armed citizens instituted in Paris 13 July 1789 for the purpose of preserving order and protecting liberty. At first it numbered 48,000 men, but was increased to 300,000 when it was organized throughout the whole country. Acting as a royalist and reactionary force, it was crushed by Napoleon in 1795. It was reorganized by the Directory and by Napoleon and again under the Bourbons, to whom, however, it was a source of such disquietude that it was dissolved by a royal ordinance in 1827. Under Louis Philippe it was resuscitated in its old form and contributed to his overthrow. In 1851 the national guard was again reorganized, but in 1855 it was dissolved. In 1870 the national guard of Paris was again formed for the defense of the city against the Prussians. The resistance of a section of the guard to the decree of disarmament issued under M. Thiers led to the communal war, at the close of which the guard was declared dissolved by the National Assembly (1871).

Garden, Alexander, Scottish scientist: b Charleston, S. C., about 1730; d. London 15 April 1791. He was graduated from Aberdeen; became a professor in King's College, New York (now Columbia University), and in 1755 established himself in medical practice at Charleston. From 1783 he was in London, where he became vice-president of the Royal Society. The botanical genus *Gardenia* (q.v.) was named in his honor by Linnæus. He wrote various papers on topics of botany and zoology.

Garden, Alexander, American soldier: b. Charleston, S. C., 4 Dec. 1757; d. there 29 Feb. 1829. He was for a time aide-de-camp to Gen. Greene. He wrote 'Anecdotes of the Revolutionary War in America, with Sketches of Character of Persons the most distinguished in the Southern States for Civil and Military Services' (1st series, Charleston, 1822; followed by a second series), which is one of the authorities for the history of the period, containing information hardly to be found elsewhere.

Garden. The earliest known gardens are those of Solomon which are described as having been of quadrangular form, surrounded by high walls. They contained aviaries, wells, and streams of water. The gardens of Cyrus and other Persian monarchs were of great extent, and generally laid out in romantic situations. They were also distinguished for the great diversity of their uses and products. The first allusion to terraces in gardens is to be found in the description of the celebrated hanging gardens of Babylon, anciently reckoned among the wonders of the world. Their construction is variously ascribed to Queen Semiramis and to Nebuchadnezzar. Diodorus and Strabo have given descriptions of them. They are said to have formed a square with an area of nearly four acres, and rose in terraces, supported on masonry arches, to a height of 75 feet. They were irrigated from a reservoir built at the top, to which water was lifted from the Euphrates by a screw. Fountains and banqueting-rooms were distributed throughout the numerous terraces; groves and avenues of trees, as well as parterres of flowers, diversified the scene; while the view of the city and neighborhood was extensive and magnificent. Most of the elements of a modern architectural garden are alluded to in connection with those of Babylon. The grove of Orontes, described by Strabo, must be regarded as a park or large garden in the picturesque style; it was nine miles in circumference.

In ancient Greece, gardening was rather a neglected art at first, but in process of time great advance was made. The vale of Tempé, the Academus at Athens, and other public gardens, were extremely elegant, and were ornamented with temples, altars, tombs, statues, monuments, and towers. The Greeks copied their gardening from the Persians; and the Romans, in their turn, copied that of the Greeks. Little is known of the early style of Roman gardening; the vast edifices projecting into the sea, and the immense artificial elevations, are apparently ridiculed by Cicero and Varro. About this time, however, began the cultivation of odoriferous trees and plants; and the planting of trees adjoining each other, whose odors assimilated, was then as much a study with the garener as the harmonious blending of colors at the present day.

The early French and Dutch gardens were evidently adopted from the description of Pliny's garden. The use of glass in the construction of conservatories was early known to the Greeks and Romans; and the "Gardens of Adonis," mentioned by some of their most eminent authors, were probably of this kind. Gardening, like all the other arts, languished during the Dark Ages, but with the revival of learning, the invention of printing, and the Reformation, it began again to flourish. The art was revived and patronized by the family of the Medici in Italy; and their gardens which were of the geometric and architectural style, long served as

models for most of Europe. It continued to be imitated in France, Germany, and Great Britain till the introduction of the English or natural style. In garden architecture very little progress, as far as hothouses are concerned, has been made in southern Europe, the warmth of the climate rendering them all but useless. There are, however, plant houses in many places in Spain and Portugal. The French and Dutch gardens resemble each other closely: symmetry and profuse ornament are the characteristics of both. The Dutch style is eminently adapted to the nature of the country, where there are no inequalities of surface, as in England. The French style seems to have arisen about the middle of the 17th century, during the reign of Louis XIV. The most celebrated gardener of the period was Le Nôtre, who laid out the famous gardens of Versailles. Le Nôtre's style spread rapidly into other countries. The first erection of hothouses in France occurred toward the end of the reign of Louis XIV., by M. Fagon, in the Jardin des Plantes. The first magnificent attempt at hothouse building was that of Francis I., of Austria, in 1753. They were in five ranges, extending altogether to the length of 1,290 feet, many of them being 30 feet high. From about 1760 landscape gardening, and the adoption of the English style, rapidly spread into France, Germany, and Russia, where it still prevails. See FLOATING ISLAND; FLORICULTURE; GREENHOUSE; HORTICULTURE; BREEDING, PLANT; FLOWERS; CROSS-FERTILIZATION; ETC.

Garden City, N. Y., a village on Long Island in Nassau County; on the Long Island R.R.; 18 miles east of New York. It was founded by Alexander T. Stewart as a residential town. It is the seat of the Protestant Episcopal bishop of Long Island, and contains the Cathedral of the Incarnation. Here are also the Cathedral Schools of St. Mary and St. Paul. Pop. (1901) 800.

Garden of the Gods, a small region in Colorado, near Colorado Springs, in which are seen some of the most striking effects of erosion ever found upon the globe. The "Garden" covers an area of about 500 acres, within which are strangely sculptured sandstone rocks, red and white, forms of grotesque magnificence — columns, "cathedral spires," and giant figures sometimes appearing almost as if made in human likeness. To many of these shapes have been given distinctive names suggested by their various formations. The road into the "Garden" enters through the huge "Gateway" of red rock-masses more than 300 feet in height.

Garden Snail. See SNAIL.

Garden Webworm. See WEBWORM.

Gardener, Helen Hamilton. See SMART, HELEN HAMILTON.

Gardener Bird. See BOWER-BIRDS.

Gardening, Landscape. See LANDSCAPE GARDENING.

Gardiner, gärd'nėr, **Asa Bird,** American lawyer: b. New York 30 Sept. 1839. He was educated at the College of the City of New York and New York University; during service in the Civil War attained the rank of captain and received a medal of honor for bravery; was professor of law in the United States Military Academy in 1874–9, and became district attorney of the County of New York in 1897. He has practised law in New York, and held important posts in the Society of the Cincinnati and other organizations.

Gardiner, Frederic, American Protestant Episcopal clergyman: b. Gardiner, Me., 11 Sept. 1822; d. Middletown, Conn., 17 July 1889. He was graduated from Bowdoin College in 1842, from the General Theological Seminary, New York, in 1845; was rector of Trinity, Saco, Me., 1845–7; rector of churches at Bath (1848–53) and Lewiston, Me. (1855–6); and in 1865 became professor of the literature and interpretation of Scripture in the Gambier (Ohio) Theological Seminary. In 1867 he was appointed professor of the Old Testament language and literature in Berkeley Divinity School (Middletown, Conn.), and in 1883 of New Testament interpretation and literature in that institution. He founded (1880) the Society of Biblical Literature and Exegesis, and published: 'The Island of Life' (1851); 'Diatessaron' (1871); 'The Old and New Testaments in their Mutual Relations' (1885).

Gardiner, John, American lawyer: b. Boston 1731; drowned off Cape Ann 15 Oct. 1793. He was a son of Sylvester Gardiner (q.v.). He studied law at the Inner Temple, London, and was admitted to practice at Westminster Hall. He formed an intimacy with Churchill and Wilkes, and was junior counsel of the latter at his trial in 1764, and also appeared for Beardmore and Meredith, who for writings in support of Wilkes had been imprisoned on a general warrant. In 1766 he procured the appointment of attorney-general in the island of St. Christopher, where he remained until after the American revolution, when he returned to Boston. After residing there a few years, he removed to Pownalborough, Me., which place he represented in the Massachusetts legislature until his death. As a legislator he distinguished himself by his efforts in favor of law reform, particularly the abolition of special pleading, and the repeal of the statutes against theatrical entertainments. In connection with the latter subject he published a 'Dissertation on the Ancient Poetry of the Romans,' and an accompanying speech. The abolition of the law of primogeniture in Massachusetts was due to his efforts. He was one of the most influential of the early Unitarians of Boston, and participated in the change of King's Chapel from an Episcopal into a Unitarian Congregational Church.

Gardiner, John Sylvester, American Episcopal clergman: b. Haverford West, South Wales, England, June 1775; d. Harrowgate, England, 29 July 1830. He was a son of John Gardiner (1731–93) (q.v.); accompanied his father to the West Indies, and subsequently studied in Boston, and in England under the celebrated Dr. Parr. Returning to America, he became a candidate for orders in the Protestant Episcopal Church, and in 1797 was ordained. In 1805 he became rector of Trinity Church, the chief Episcopal parish in Boston, with which he remained connected until his death. He was an accomplished scholar, and a forcible preacher. In the establishment of the 'Boston Anthology and Monthly Repository,' for which he was a frequent writer, he contributed materially to the dissemination of literary taste and culture in Boston. He was also one of the founders of the Boston 'Athenæum.' He wrote

the 'Jacobiniad,' a satire in prose and verse directed against the liberal clubs of Boston, to which, being in politics a strong Federalist, he had an antipathy.

Gardiner, Lion, English settler in America: b. 1599; d. 1633. After service in the English army, he came to America in 1635 as the representative of a land company which had a patent of territory at the mouth of the Connecticut. He built a fort to which he gave the name of Saybrook, compounded from the names of Lord Say and Sele and Lord Brook, two of the patentees, and remained in charge until 1639. He made on an island, called by him the Isle of Wight (now Gardiner's Island, township of Easthampton), the first English settlement within the limits of what is now the State of New York, and there he lived in baronial style.

Gardiner, Samuel Rawson, English historian: b. Ropley, Hampshire, 4 March 1829; d. Sevenoaks, Kent, 23 Feb. 1902. He was educated at Christ Church, Oxford, studied also at Edinburgh and Göttingen; was professor of history at King's College, London, in 1871–85, historical lecturer for the University Extension Society in 1880–94, and examiner in the Oxford final history school in 1886–9. He was elected to a research fellowship by All Souls, Oxford, in 1882, and to a similar fellowship by Merton in 1894. On Froude's death (1894) he declined appointment to the Oxford regius professorship of modern history. It is for his work of research in the history of England from 1603 to 1660 that he is best known. The results were published in instalments later assembled in various collective editions. In the course of his investigations he examined minutest details with extraordinary care. He inspected the scene of most battles which he described; he thoroughly familiarized himself with the state papers of the Record Office, and, for the study of the state papers foreign and the contents of other national archives, learned six continental languages. It is stated that he was the only one that ever read the entire collection of Thomasson tracts in the British Museum. Though himself a Liberal in politics, his writing was wholly judicial and impartial. Perhaps no other English historian ever labored more enthusiastically for historical truth. His style is clear and well-ordered, and in later volumes vigorous and often impressive. He was the first to describe in full the period of Commonwealth and Protectorate from an unprejudiced viewpoint, and he was also the first satisfactorily to explain the beginnings of the Cavalier party and the rise of the civil war. He was fortunately enabled to utilize many newly discovered sources. His work was not at first popular, but its worth was later fully recognized. In 1882 he received a civil-list pension of £150. The titles of the larger divisions of his great undertaking are: 'History of England from the Accession of James I. to the Disgrace of Chief Justice Coke' (1863); 'History of England from the Accession of James I. to the Outbreak of the Great Civil War' (1883–4); 'History of the Great Civil War' (1886–91); and 'History of the Commonwealth and Protectorate' (1894–1901), in three volumes, a fourth to be completed by Firth. He wrote also 'Cromwell's Place in History' (1897); 'Oliver Cromwell' (1899); and other works, including: 'The Thirty-Years' War' (1874); 'The First Two Stuarts and the Puritan Revolution' (1876) 'Introduction to the Study of English History' (with Mullinger, 1881); 'Constitutional Documents of the Puritan Revolution' (1889); 'Student's History of England' (1890–2); 'School Atlas of English History' (1891); 'What Gunpowder Plot Was' (1897).

Gardiner, Sylvester, American physician: b. Kingston, R. I., 1717; d. Newport, R. I., 8 Aug. 1786. He studied medicine in London and Paris, subsequently practised his profession in Boston, and opened there a drug establishment, from which the New England colonies were chiefly supplied. He was one of the early promoters of inoculation for the smallpox, and a liberal contributor for the erection of King's Chapel, Boston. He became possessed of large tracts of land in Kennebec County, Maine, and about the middle of the century was instrumental in establishing there the settlement of Pittston, a portion of which was subsequently set off into a separate town, under the name of Gardiner, where he built and endowed Christ Church. He retired from Boston on its evacuation by the British troops, but returned to the United States at the close of the Revolutionary War, and passed the rest of his life there.

Gardiner, Me., a city in Kennebec County, on the Kennebec River, and on the Maine C. R.R., six miles from Augusta. It has admirable water-power, valuable manufacturing interests, and an assessed property valuation of $4,000,000. The ice-cutting industry employs 1,000 people, with an annual output valued at $75,000. Pop. (1900) 5,501.

Gardiner's Island, N. Y., an island in a bay of the same name at the northeastern extremity of Long Island. It is part of the township of East Hampton, Suffolk County, and has an area of 3,300 acres, mostly undulating pasture land. It was colonized by an English family of the name of Gardiner in 1639 and is in possession of lineal descendants of the original settlers. Captain Kidd (q.v.) buried part of his treasures on the island in 1699, but they were recovered in the same year by the colonial authorities.

Gardner, Elizabeth Jane, American artist: b. Exeter, N. H., 1842. She was a pupil at Paris of Bougereau, Merle, and J. J. Lefebvre, and has exhibited much in the United States and foreign countries. Among her works are several portraits: 'Cinderella'; 'Fortune-Teller'; 'Moses in the Bulrushes.'

Gardner, Ernest Arthur, English archæologist: b. London 1862. He was educated at Cambridge University, and was director of the British School of Archæology at Athens, 1887–95. From 1884 he has been engaged in archæological researches in Athens, Paphos in Cyprus, Megalopolis, and elsewhere, and has lectured and written much upon Greek art and archæology.

Gardner, Eugene C., American architect: b. Ashfield, Mass., 28 March 1836. He was principal of the Academy at Tallmadge, Ohio, 1852–62. He then removed to Northampton, Mass., where he resided 1863–8, engaged in architectural work, going to Springfield, Mass., in the latter year, editing 'The Builder' 1885–7, and writing for the 'Springfield Republican.'

In 1901 he was elected a member of the Massachusetts House of Representatives. Among his works are: 'Homes and How to Make Them'; 'Illustrated Homes'; 'Home Interiors'; 'The House that Jill Built'; 'Town and Country School Houses'; and 'Common Sense in Church Building.'

Gardner, George Clinton, American engineer and railway official: b. Washington 1834; d. Richmond Hill, L. I., 12 Aug. 1904. He studied at Columbia for a time, in 1850 became connected with the survey establishing the United States and Mexican boundary from the Gulf of Mexico to the Pacific. In 1856 he was commissioned by the government assistant astronomer and surveyor of the Northwest boundary, and in this survey, for establishing and marking the 49th parallel, he gained considerable distinction. His determinations along this line form the initial points of the United States land surveys. He resigned in 1869, and subsequently was prominently identified with various railway interests. He was general manager of the Mexican National Construction Company, the Mexican National Railroad Company, and the Texas-Mexican Railroad Company, constructing much of these lines, and was connected also with other railways.

Gardner, Percy, English archæologist: b. Hackney, Middlesex, 24 Nov. 1846. He was educated at Cambridge University, was Disney professor of archæology there in 1880, and has been professor of classical archæology at Oxford from 1887. Among his publications are: 'Samos and Samian Coins' (1882); 'The Types of Greek Coins' (1883); 'New Chapters in Greek History' (1892); 'Manual of Greek Antiquities,' with Jevons (1895); 'Sculptured Tombs of Hellas' (1896); 'Exploratio Evangelica' (1899); 'Historic View of the New Testament' (1901); 'A Grammar of Greek Art' (1905).

Gardner, Mass., a town in Worcester County, including the villages of Gardner Centre, South Gardner, and West Gardner. It is situated about 25 miles north of Worcester, on the Fitchburg division of the Boston & M. R.R., two branches of which pass through the town, intersecting at the station in Gardner Centre. Gardner is the trade centre of an agricultural region, and has a large chair-manufacturing industry, with establishments employing about 3,000 people. Almost every known kind of chair is made here, and the products of this manufacture are shipped to all parts of the United States and to many foreign countries. The town has two good parks and an excellent public library. Pop. (1900) 10,813.

Garefowl, or **Great Auk.** An extinct auk (*Plautus impennis*), much like the existing razor-bill, but larger (nearly the size of a goose), with a larger bill and relatively smaller wings. It was black above and white below, with a conspicuous white patch in front of the eye. It was an expert swimmer and diver, but unable to fly on account of the very small size of its wings. The habits of the garefowl were those of auks generally, but its range was limited on the American coast to the vicinity of Newfoundland. It seems never to have lived north of the Arctic Circle; but its bones in shell-heaps testify to its former occurrence, at least in migrations, southward as far as Florida. These birds bred on small islands off the coast of Iceland, and on the Orkneys and Hebrides. Early in the 19th century they disappeared from these haunts, mainly through the persecution of fishermen and sailors who had for years killed them for food, bait, and feathers; but they lingered somewhat longer in the gulf of Saint Lawrence. Cartier's vessels visited Funk Island in 1534, and the crews easily filled two boats with the birds which they knocked down with sticks; and their abundance was mentioned as one of the inducements for settlers to come to Newfoundland. For many years the colony was ruthlessly harried, yet a few pairs survived until about 1840. A small breeding-place remained in Iceland until 1844, when the last few pairs were killed as museum specimens. The skins of this auk have been sold for $650, and an egg for $1,500. Seventy-eight specimens of the bird were preserved in museums throughout Europe and America in 1903. Consult: Newton's 'Dictionary of Birds,' article 'Garefowl,' and articles by F. A. Lucas in 'Report United States National Museum for 1887–8,' and for 1888–9.

Garfield, James Abram, twentieth President of the United States: b. Orange, Cuyahoga County, Ohio, 19 Nov. 1831; d. Elberon, N. J., 19 Sept. 1881. On his father's side he was of English Puritan descent; on his mother's, Huguenot. The father, a native of New York, settled in the "Western Reserve" in 1830, and died in 1833, leaving his widow with four small children, James being the youngest. Garfield's boyhood was passed amid the harsh but by no means destitute conditions of frontier life. He worked hard on the farm, helped in the support of the family, attended school three months each winter, and read and re-read every book which fell in his way. For a short time he was a driver and steersman on the Ohio Canal. Supporting himself chiefly by teaching, he studied successively at Geauga Seminary 1849, Eclectic Institute, Hiram, Ohio (now Hiram College), 1851–4, and Williams College, Mass., entering the junior class in 1854 and graduating with high honors in 1856. Returning to Ohio, he taught the classics at Hiram Institute 1856–7, and became its president 1857–9. Coincident with his teaching he studied law, was admitted to the bar in 1859, and, resigning his presidency, was elected to the Ohio State senate. The Civil War breaking out, he threw himself enthusiastically into the Northern cause, was commissioned lieutenant-colonel of the 42d Ohio, and given command of a brigade, with orders to operate as an independent force in eastern Kentucky, December 1861. With a force of 1,100 men and no artillery he signally defeated 5,000 Confederates under the veteran general, Humphrey Marshall, driving them from fortified positions of their own choosing, 10 Jan. 1862. For this exploit Lincoln promoted him brigadier-general. Subsequently he took part in the battle of Shiloh, in the operations around Corinth, and served with distinction on several courts-martial at Washington, one being that of Gen. Fitz-John Porter (q.v.). Appointed chief of staff to Gen. Rosecrans, February 1863, his notable services at Chickamauga (see CHICKAMAUGA, BATTLE

OF) caused Lincoln to make him a major-general, 19 Sept. 1863. In 1862 his home district had elected him to Congress. Thus, within six years he had been president of a college, State senator, major-general, and representative-elect, a combination of honors without parallel in the national annals. Upon the advice of Lincoln and Stanton he resigned his major-general's commission 5 Dec. 1863 and took his seat as a representative on December 7. In this field his talents and genius found their true sphere. He stepped to the front at once, taking a prominent part in every debate of importance, and becoming an authority on questions of finance; tariff, education, and constitutional rights. Always the champion of sound money, his speech in March 1866 clearly outlined the policy which resulted in the resumption of specie payments 1 Jan. 1879. An eminent contemporary has well said of Garfield's speeches that they are a compendium of the political history of the time, and would give a connected history and complete defense of the important legislation of the 17 eventful years that comprised his legislative career. He was eight times re-elected to Congress, serving on such important committees as those on military affairs and on ways and means, and was the first chairman of the committee on banking and currency. In the Reconstruction period he steadily opposed the theories of President Johnson (see JOHNSON, ANDREW); in 1876 he went to New Orleans at President Grant's request to watch the counting of the Louisiana vote, and in 1877 was chosen by acclamation one of the two members of the Electoral Commission allotted to the House of Representatives. In the 45th Congress Garfield displayed masterly qualities as a leader of opposition. His speech at Faneuil Hall, Boston, in 1878 on the national finances was circulated by thousands as a campaign document. On 13 Jan. 1880 the Ohio legislature unanimously elected him United States Senator to succeed Hon. Allen G. Thurman (q.v.), and his last speech in Congress was delivered 23 April 1880. At the Republican National Convention at Chicago, 2–8 June 1880, he headed the Ohio delegation, nominated John Sherman (q.v.) for the Presidency, opposed the nomination of Gen. Grant for a third term, and was himself nominated on the 36th ballot as a compromise candidate. Contrary to all precedent, Garfield himself took part in the campaign that followed, making some 70 speeches in all, chiefly extemporaneous. At the November election he received 214 electoral votes to 155 given his Democratic opponent, Gen. Hancock. The first months of Garfield's administration were disturbed by the opposition of the New York senators to certain of his appointments. Senators Conkling and Platt claimed the right to control the Presidential appointments in their State. This the President refused to concede. The senators resigned and appealed to their legislature to vindicate their attitude by a re-election, but failed to get it. On the morning of 2 July 1881, while in the Baltimore & Ohio station at Washington, on his way to New England, where he intended to deliver the commencement address at Williams College, President Garfield was shot by Charles Jules Guiteau (q.v.), a disappointed office-seeker. For weeks he lingered between life and death, suffering the greatest agony but bearing it with a magnificent fortitude that won the admiration and sympathy of the civilized world. A removal to Elberon, N. J., in the hope that the sea air might benefit him was of no avail. Blood poisoning set in on 15 September, and he died on the 19th at 10:30 P.M. In February 1882 an impressive memorial service was held in the House of Representatives, the Hon. James G. Blaine delivering a commemorative address, which, for eloquence, dignity, and truth, has rarely been equaled on such occasions. Garfield's body lies in a beautiful cemetery in Cleveland, Ohio, a stately monument marking the spot. His life was the fullest realization of the opportunities of American citizenship. Rising from nothing, by his own exertions he won high places in various spheres and filled them all adequately and with dignity.

No definitive 'Life' has yet appeared, the biographies of Garfield by J. M. Bundy, C. C. Coffin, and J. R. Gilmore (all 1880) being incomplete and unsatisfactory. His 'Works' have been edited by Prof. B. A. Hinsdale (1882–3).

W. N. C. CARLTON,
Librarian Trinity College, Hartford.

Gargano, gär-gä'nō (ancient Garganus), a mountainous peninsula, the "spur" of Italy, in the province of Foggia, jutting out into the Adriatic Sea, and attaining in Monte Calvo a height of nearly 4,000 feet. Bee-keeping is yet as generally engaged in as in the time of Horace. The district is visited mainly by pilgrims to a shrine of Saint Michael on Monte Saint Angelo. It is about 50 miles long and 27 miles broad.

Garguntua, gär-gan'tū-ä, the hero of Rabelais' satire, so named from his father exclaiming "*Que grand tu as!*" "How large (a gullet) thou hast!" on hearing him cry out, immediately on his birth, "Drink, drink!" so lustily as to be heard over several districts. It required 900 ells of linen for the body of his shirt, and 200 more for the gussets, 1,100 cow hides for the soles of his shoes, and he picked his teeth with an elephant's tusk.

Gargoyle, Gargoil, or **Gurgoyle** (French *gargouille* = the weazand of the throat), in architecture, a quaintly-formed head of a man or animal, employed as a decorative spout for the rain-water from a roof. The most common form was that of a dragon projecting from the roof-gutter, but the varieties are innumerable. They were used in all styles of architecture, and are many of them of a most hideous appearance.

Garfield Monument, a monument erected as a memorial to President Garfield, in the Lakeview Cemetery at Cleveland, Ohio. See CLEVELAND.

Garibaldi, Giuseppe, joo-sĕp'pĕ gä-rē-bäl'dē, Italian patriot: b. Nice, France, 4 July 1807; d. island of Caprera, Italy, 2 June 1882. His father being a poor fisherman, he received little education, and for a number of years was a sailor on various trading vessels. In 1834, being condemned to death for his share in the

JAMES ABRAM GARFIELD,

TWENTIETH PRESIDENT OF THE UNITED STATES.

schemes of Mazzini, he escaped to Marseilles and finally went to South America. In the service of the Republic of Rio Grande against the Brazilians he became known as a brilliant leader, and with his famous Italian legion he subsequently gave the Montevideans such effective aid against Buenos Ayres as to earn the title of "hero of Montevideo." In 1848 he returned to Italy, raised a band of volunteers, and harassed the Austrians till the re-establishment of Austrian supremacy in Lombardy. In the spring of 1849 he proceeded to Rome to support Mazzini's republic. He was appointed to command the forces, but the odds were overwhelming, and after a desperate defense of 30 days Garibaldi escaped from Rome with 4,000 of his followers. He reached the United States, and was for several years in command of a merchant vessel. He then purchased a part of the small island of Caprera, off the north coast of Sardinia, and made this his home for the rest of his life. Latterly the subscriptions of his admirers enabled him to become owner of the whole island.

In the war of 1859, Garibaldi and his Chasseurs of the Alps did splendid service; and on the revolt of the Sicilians in 1860 he crossed to the island, wrested it after a fierce struggle from the king of Naples, recrossed to the mainland and occupied Naples, where he was proclaimed dictator of the Two Sicilies. He readily acquiesced in the annexation of the Two Sicilies to Italy, and declining all honors retired to his island farm. In 1862 he endeavored to force the Roman question to a solution, and entered Calabria with a small following, but was taken prisoner at Aspromonte by the royal troops. He was soon released, however, and returned to Caprera. In 1864 he received an enthusiastic welcome in Great Britain. In 1866 he commanded a volunteer force against the Austrians in the Italian Tyrol, but failed to accomplish anything of consequence. Next year he attempted the liberation of Rome, but near Mentana was defeated by the French and pontifical troops, and was again imprisoned by the Italian government, but soon pardoned and released. In 1870 he gave his services to the French republican government against the Germans, and at the end of the war was elected a member of the French Assembly, but speedily resigned his seat and returned to Caprera. Rome now became the capital of united Italy, and here in January 1875, Garibaldi took his seat in the Italian Parliament. The latter part of his life was spent quietly at Caprera. After 1870 he wrote two or three novels of very mediocre quality. His autobiography was published in 1887, and translated into English with a supplementary biography in 1889.

Garibaldi (fish), a small, brilliantly colored, edible fish (*Hypsypops rubicundus*), scarlet when adult, which dwells in rocky pools along the coast of southern California, hiding and finding its food among the seaweeds.

Garigliano, gä-rēl-yä'nō, a river in southern Italy, formed by the junction of the Liri and Sacco near Pontecorvo. It flows southeast and southwest, and after a course of 40 miles falls into the Gulf of Gaëta.

Garland, Augustus Hill, American lawyer: b. near Covington, Tenn., 11 June 1832; d. Washington, D. C., 26 Jan. 1899. He opposed secession as a policy, but was afterward elected to the Confederate Senate, which office he held till the close of the War. In 1874 he was elected governor under the new Constitution of Arkansas, and in 1885 became attorney-general in the cabinet of President Cleveland.

Garland, Hamlin, American novelist: b. West Salem, Wis., 16 Sept. 1860. His works include: 'Main Traveled Roads' (1891); 'A Spoil of Office'; 'Prairie Folks'; 'Jason Edwards' (1891); 'A Member of the Third House' (1892); 'Prairie Songs' (1893); 'A Little Norsk' (1893); 'Crumbling Idols' (1894); 'Rose of Dutcher's Coolly' (1895); 'Wayside Courtships' (1897); 'The Eagle's Heart' (1901); 'Captain of the Gray Horse Troop' (1902); 'The Tyranny of the Dark' (1904); etc.

Garland, Landon Cabell, American educator: b. Livingston, Va., 21 March 1810; d. 1895. He was graduated at Hampden-Sidney College, Virginia, was professor of chemistry at Washington College in that State 1830–3, at Randolph-Macon College 1833–5, and became president of the latter in 1835. In 1847–53 he was professor of astronomy and mathematics at the University of Alabama, in 1855–66 its president; later was professor of physics in the University of Mississippi, and chancellor of Vanderbilt University.

Garlic (*Allium sativum*), a species of onion cultivated in Europe since the year 1551. The leaves are grass-like, and differ from those of the common onion in not being fistulous. The stem is about two feet high, terminated by a head composed principally of bulbs instead of flowers; the flowers are white; the root is a compound bulb, consisting of several smaller bulbs, commonly denominated cloves, enveloped by a common membrane. Garlic has a strong, penetrating odor, and a pungent acrid taste. It differs from the onion only by being more powerful in its effects. In warm climates, where garlic is considerably less acrid than in cold ones, it is much used both as a seasoning and as food. In the south of Europe, particularly in Spain, and among Italians in the United States, it enters into the composition of almost every dish, not only among the common people, but among the higher classes of society. At all times, however, while it has been prized by some nations it has been detested by others, as by the ancient Greeks. Its cultivation is easy, and it is reproduced by planting the radical or floral bulbs. Its medicinal virtues are celebrated.

Garlic, Oil of. When the leaves, seeds, or bulbs of garlic and other allied plants are distilled with steam, about 0.2 per cent of a brown oil, with acrid taste and strong disagreeable odor, passes over. By purification it is obtained as a pale yellow oil having the odor of garlic, and it is then found to consist of the sulphide of allyl $(C_3H_5)_2S$. This oil is nearly related to the pungent oil of mustard, C_3H_5NCS, an isomer of the sulphocyanide of allyl, and is of much interest chemically, but it is of no importance from an industrial point of view.

Garman, Harrison, American naturalist: b. Lena, Ill., 27 Dec. 1858. He was graduated at the State Normal University and studied later at Johns Hopkins University. He has held many professional positions, among them being entomologist and those of professor of zoology

and entomology at Kentucky State College, 1892-6, and State entomologist of Kentucky since 1897.

Garman, Samuel, American naturalist: b. Indiana County, Pa., 5 June 1846. He was graduated at the Illinois State Normal University in 1870, and became assistant in herpetology and ichthyology in the Museum of Comparative Zoology, Cambridge, Mass., in 1873. His works include: 'The Reptiles and Batrachians of North America'; 'Chlamydoselachus'; 'The Evolution of the Rattlesnake'; etc.

Garner Case, 1856, the most tragic of the fugitive-slave cases. Simon Garner, his wife, and his son Robert, slaves of John Marshall of Kentucky, and Robert's wife Margaret and their four children, slaves of A. R. Gaines, ran away, crossed the Ohio on the ice, and took refuge with a Cincinnati colored man. Gaines tracked them, secured a warrant, and with a deputy marshal and a band of assistants attacked the house. After a desperate fight the fugitives were overpowered, one of the posse being badly wounded; but Margaret, who had shared in the conflict, found time before her capture to murder one of the children, severely cut the throats of two others, and considerably bruised the baby, to keep them from returning to slavery. In sympathy with them, and to establish their freedom as denizens of Ohio, a Cincinnati judge issued a writ of habeas corpus, and the grand jury indicted Margaret for the murder of her child, and her husband and his father as accessories. The United States fugitive-slave law of 1850 prevailed, however; the slaves were given back to their owners and sent down the river. On the voyage Margaret jumped overboard with the baby; she was rescued, but the child was lost, at which she expressed satisfaction.

Garnet. See GEMS.

Gar'nett, James Mercer, American philologist: b. Aldie, Va., 24 April 1840. He was graduated at the University of Virginia in 1859; served in the Confederate army during the Civil War; and was professor of English language and literature in the University of Virginia 1882-96. He is the author of: 'Translation of Beowulf'; 'Elene and Other Anglo-Saxon Poems'; 'History of the University of Virginia.'

Garnett, Richard, English poet and librarian: b. Lichfield, Staffordshire, 27 Feb. 1835; d. London, 13 April 1906. He was appointed in 1851 assistant in the printed book department of the British Museum, became superintendent of the reading-room in 1875, but resigned in 1884 to devote himself more exclusively to the printing of the 'Museum Catalogue,' of which he had had charge from its commencement. He published: 'Primula: a Book of Lyrics' (1858); 'Egypt and Other Poems' (1859); 'Poems from the German' (1862); 'Relics of Shelley' (1862); 'Idylls and Epigrams' (1869); 'Selections of Shelley's Poems' (1880); 'Letters' (1882); 'Life of Carlyle' (1887); 'Life of Emerson' (1887); 'Twilight of the Gods' (1888); 'Life of Milton' (1890); 'Iphigenia in Delphi' (1891); 'Poems' (1893); 'William Blake: Painter and Poet' (1895); 'The Age of Dryden' (1895); 'One Hundred and Twenty-four Sonnets from Dante, Petrarch and Camoens' (1896); 'Richmond on the Thames' (1896); 'Life of Edward Gibson Wakefield' (1898); 'History of Italian Literature' (1898); 'Essays in Librarianship and Bibliography' (1899); 'The Queen and Other Poems' (1901); 'Essays of an Ex-Librarian' (1901); etc. He also contributed extensively to the magazines and cyclopædias. He resigned from the Museum in 1899.

Garnett, Robert Selden, American soldier: b. Essex County, Va., 16 Dec. 1819; d. Carrick's Ford, Va., 13 July 1861. Graduated from the United States Military Academy in 1841 and made brevet 2d lieutenant of artillery, he served on the northern frontier during the Canadian border disturbances, and distinguished himself in the war with Mexico (1846-8), receiving the brevet of major for his conduct at Buena Vista. He was transferred to the Seventh infantry in 1848, fought in Florida against the Seminoles, and was commandant at West Point in 1852-4. In 1855 he was promoted major of infantry, and in 1856 commanded the expedition against the Indians of Puget Sound. At the outbreak of the Rebellion in 1861 he resigned his commission, and was made adjutant-general, with colonel's rank, to organize the Virginia forces. Shortly afterward he was appointed brigadier-general, C. S. A., and given command of the troops in the western part of Virginia. While endeavoring to retreat to Beverly, he was overtaken by the Federals at Carrick's Ford, Cheat River, and took command of a detachment with which he sought to cover the retreat. His force was routed, and he was killed during the combat.

Garnett, Kan., city and county-seat of Anderson County, on the Pottawattomie River, and on the Missouri P. and the Atchison, T. & S. F. R.R.'s, 45 miles northwest of Fort Scott. It has good educational institutions, including a United Presbyterian college. There are large manufactures of furniture, and also of cheese. Pop. (1900) 2,078.

Garnier, Jean Louis Charles, zhŏṅ loo-ē shärl gär-nē-ā, French architect: b. Paris 6 Nov. 1825; d. 4 Aug. 1898. He was a pupil of Levieil and Lebas at the Beaux-Arts, won the Prix de Rome in 1848 with his design for a conservatory of arts and industries, traveled in Italy, Turkey, and Greece, and in 1861 won the competitive prize for plans of the new Paris Opera. In 1863-74 he superintended the construction of this costly and important work, whose chief feature is its grand staircase, but which is by some thought to be overladen with accessories of painting and sculpture. In addition to this, his principal achievement, he designed buildings public and private at Paris and elsewhere. He was the author of: 'Travers les Arts' (1869); 'L'habitation humaine,' with Ammann (1892); and editor 'Le nouvel Opéra de Paris' (1876-81).

Garnier, Marie Joseph François, commonly known as FRANCIS, French explorer: b. Saint-Etienne 25 July 1839; d. Hanoi, Tongking, China, 2 Dec. 1873. He entered the French navy, served in the war with China in 1860-2, and became a civil officer in the newly established colony of Cochin-China. In 1866 he was appointed to assist Capt. Doudart de Lagrée in an exploring expedition which set out from the

coast of Cambodia and proceeded through Yunnan to Shanghai, the purpose being to open a highway of trade. Garnier explored the river Mekong, and, on the death of Doudart de Lagrée, assumed command of the expedition, which he brought successfully along the Yang-tse-kiang to Shanghai. The geographical societies of France and Great Britain bestowed numerous honors upon him. He took part in the defense of Paris in 1870–1, and again undertook explorations in China. The governor of Cochin-China empowered him to negotiate a treaty with the viceroy of Tongking. Upon the refusal of the viceroy to open negotiations, Garnier captured Hanoi, the capital, and achieved further victories with a force of but 120. He was finally killed in an ambush. His 'Voyage d'Exploration en Indo-Chine pendant 1866–8' (1873) is a notable book.

Garnierite, a green, amorphous mineral, one of the most important ores of nickel. It is a hydrous silicate of nickel and magnesium, the ratio of the two metals varying widely. It is soft and very brittle and has a specific gravity of 2.3 to 2.8. It is extensively mined in New Caledonia, and also occurs in large quantities in Douglas County, Ore., and Jackson County, N. C. It was named after the French geologist, Garnier.

Garnishment, in law, a process by which a third person, in whose possession the effects of the defendant are attached, is warned not to turn over such effects to the defendant, but to appear in court and give information. This process is controlled by statute in the States where it exists, and the demands of the statutes must be fully met by any plaintiff seeking to make use of the process. The process is called in some States trustee process, in others factorizing, and in still others attachment, the more general title. The third party, who is known as the garnishee, is liable for only such property as is not encumbered by trusts and may be delivered by the officer serving said process. Virtually, the process is a secondary suit brought by the suing creditor against the third party, or garnishee, the creditor claiming the rights of the defendant in the primary action.

Garofalo, Benvenuto, bān-vā-noo'tō gä-rō'fä-lō (originally Benvenuto Tisi da Garofalo), Italian painter: b. Ferrara 1481; d. there 6 Sept. 1559. In this city and in Cremona he cultivated his talents for painting; but the masterpieces of art in Rome exercised the greatest influence upon him. In the year 1505 he is said to have returned to Rome, and to have formed a very close intimacy with Raphael, who often made use of his assistance. He afterward painted for Alfonso I., in his native city. Garofalo's works show the influence of all the schools, particularly of the Lombard, and still more so of Raphael's, whom he surpassed in coloring. Most of his works are at Rome. Several of them, however, are in the galleries of Vienna and Dresden.

Garonne (Lat. *Garumna*), a river of southwestern France, the chief one of that section; rising in the Pyrenees, at the foot of Mount Maladetta, in the Val d'Aran, within the Spanish border. It enters France at a distance of 26 miles from its mouth. The Garonne flows in a general northeasterly direction through the department of Haute-Garonne to Toulouse, whence it proceeds in a northwesterly course. Some 20 miles below Bordeaux it forms a junction with the Dordogne; it then takes the name Gironde, and enters the Atlantic Ocean by an estuary of 50 miles in length. The complete length of the river is about 400 miles. Ocean-going steamers may ascend to Bordeaux, and the river is navigable to Toulouse and beyond. From Toulouse the Canal du Midi extends to the Mediterranean. Several destructive floods have taken place, that of 1875 having caused special damage. With its 32 tributaries the Garonne offers a system of waterways navigable for more than 1,400 miles, — a total exceeding that afforded by any other French stream. The total drainage area approaches 38,000 square miles.

Garrard, Kenner, American soldier: b. Cincinnati, Ohio, 1830; d. there 15 May 1879. He was graduated from the United States Military Academy in 1851, was made brevet 2d lieutenant in the artillery, but in 1852 was transferred to the dragoons, and after service, largely in the Northwest, was made captain of cavalry in 1861. During the early part of the Civil War he was in the commissary-general's office at Washington, and in 1861–2 commandant at West Point. In September 1862 he was commissioned colonel of the 146th New York volunteers, which he commanded at Fredericksburg, Chancellorsville, and Gettysburg. For services in the last named battle he was brevetted lieutenant-colonel. In 1863 he was promoted brigadier-general of United States volunteers, and afterward he participated in the combat at Rappahannock Station and the Mine Run operations. He took part, also, in the invasion of Georgia, was brevetted colonel for services in the expedition against Covington, Ga., and from December 1864 to July 1865 commanded the second division of the Sixteenth army corps. He distinguished himself by his efficiency in the battle before Nashville, and in the operations against Mobile; led the storming column which finally captured Blakely (9 April 1865); and was in command of the district of Mobile in August–September 1865. Mustered out of the volunteer service in August 1865, he was assistant inspector-general of the department of the Missouri in 1866, and in November 1866 resigned from the army, being at that time major, with the brevet of major-general for gallant and meritorious services in the field during the Rebellion.

Garrett, Alexander Charles, American Protestant Episcopal bishop: b. Ballymot, County Sligo, Ireland, 4 Nov. 1832. He was graduated from Trinity College, Dublin, in 1855; was ordained priest in 1857; held the curacy of East Worldham, Hampshire, in 1856–9; was a missionary in British Columbia in 1859–69; rector St. James', San Francisco, in 1870–2; and dean of Trinity Cathedral, Omaha, 1872–4. In 1874 he became missionary bishop of northern Texas, and subsequently bishop of Dallas. His publications include: 'The Eternal Sacrifice'; 'The Philosophy of the Incarnation'; 'Historical Continuity.'

Garrett, Edmund Henry, American artist: b. Albany, N. Y., 19 Oct. 1853. He was a pupil in Paris of Laurens, Boulanger, and J. J. Lefebvre, and exhibited much in America and at the Paris Salon. In 1890 he received a medal at Boston. He also published: 'Romance and

Reality of the Puritan Coast' (1897); and 'The Pilgrim Shore' (1900).

Garrett, John Work, American railway official: b. Baltimore 1820; d. 1884. He studied at Lafayette College, became a director of the Baltimore & Ohio Railroad (1857), and its president, greatly developed the road, and made it during the Civil War a most important medium for the transportation of Federal supplies and troops.

Garrett, William Robertson, American educator: b. Williamsburg, Va. 12 April 1839. He was graduated from William and Mary College in 1858, studied law in the University of Virginia, served in the Confederate army, was long occupied in educational work in the South, and was State superintendent of public instruction in Tennessee 1891–3. In 1895 he became professor of American history in Peabody Normal College, and in 1899 dean of the institution. He has published 'The South Carolina Cession and the Northern Boundary of Tennessee' (1884); 'History of Tennessee,' with Goodpasture (1900).

Garrick, David, English actor: b. Hereford, England, 19 Feb. 1717; d. London 20 Jan. 1779. His grandfather was a French refugee, his father a captain in the army. He was educated at the grammar school at Lichfield. He gave an early proof of his dramatic tendency by inducing his school-fellows to act the 'Recruiting Officer,' in which he himself took the part of Sergt. Kite, being then only 12 years of age. Later he was placed with a brother under Dr. Samuel Johnson. In 1741 he joined Giffard's company at Ipswich, where under the name of Lyddal he played with uniform success.

At this time the stages of the metropolis were but indifferently supplied with leading performers, so that when Giffard, who was manager of a theatre in Goodman's-fields, introduced his accomplished recruit there, 19 Oct. 1741, the effect was immediate and decisive. He judiciously chose the part of Richard III., which did not require that dignity of person in which he was deficient, while it gave him scope for all the strong marking of character and changes of passion in which his principal excellence consisted. He at the same time adopted a natural mode of recitation, which was a daring innovation on the part of a new performer before audiences accustomed to the artificial declamation of the school which preceded him. He afterward visited Dublin, where his success was even greater than in the metropolis, and in 1745 became joint manager with Sheridan of a theatre there. In 1746 he was engaged for the season at Covent Garden, and at its close purchased Drury Lane, and opened it 15 Sept. 1747, with the 'Merchant of Venice,' to which Dr. Johnson wrote a prologue for the occasion. This period formed an era in the English stage, from which may be dated a comparative revival of Shakespeare, and a reform both in the conduct and license of the drama. In 1749 he married Eva Marie Violetti (1724–1822), and his married life seems to have been happy. The remainder of his theatrical career was an uninterrupted series of success and prosperity. He had written, while an actor, his farces of 'The Lying Valet'; 'Lethe,' and 'Miss in Her Teens'; and in 1766 he composed, jointly with Colman, the excellent comedy of 'The Clandestine Marriage.' The year 1769 was signalized by the famous Stratford jubilee — a striking proof of his enthusiasm for Shakespeare. It occupied three days at Stratford, and its representation at the theatre lasted for 92 nights. The last part which he performed was Don Felix in 'The Wonder,' for the benefit of the theatrical fund. At the conclusion of the play he addressed a brief farewell to the audience. The general feeling with which this was delivered and received rendered it truly impressive. His remains were interred in Westminster Abbey, his funeral being attended by a numerous assemblage of rank and talent. As an actor Garrick has rarely been equaled for truth, nature, and variety and facility of expression, for which his countenance appears to have been admirably adapted. Expression and the language of passion formed his great strength, as he was equaled by many of his contemporaries in the enunciation of calm, sentimental, and poetical declamation. His literary talents were respectable, but not eminent; besides the pieces already mentioned he wrote some epigrams, a great number of prologues and epilogues, and a few dramatic interludes, and made many and sometimes judicious alterations of old plays. A collection of his works was published in London (1768–98), and his correspondence 1831–2. See Knight, 'Life of David Garrick' (1894).

Gar'rigan, Philip Joseph, American Roman Catholic prelate: b. Cavan, Ireland, 8 Sept. 1840. While he was still very young the family came to America and settled in Massachusetts and in the schools of that State he received his elementary education. He afterward studied at Saint Charles' College, Maryland, later taking an ecclesiastical course at Saint Joseph's seminary, Troy, N. Y., where on 10 June 1870 he was ordained priest. He was then appointed assistant in Saint John's Church, Worcester, Mass. In 1873 he became vice-president of the Troy Seminary and after three years was recalled to the diocese of Springfield. In 1888 he was chosen vice-rector of the Catholic University, Washington, D. C., and continued to hold the vice-rectorship until 21 March 1902, when Pope Leo. XIII. selected him for the newly-created episcopal see of Sioux City. He was consecrated bishop at Springfield, Mass., 25 May 1902. Though but two years established, the diocese now (1905) has a Catholic population of 50,000; 103 priests; 123 churches; 45 parochial schools; 1 hospital, and a Young Ladies' Home.

Garrison, George Pierce, American historical scholar: b. Carrollton, Ga., 19 Dec. 1853. He was educated at Sewanee College, Tenn., and the universities of Edinburgh and Chicago; became instructor in English and history in the University of Texas in 1884, assistant professor of history in 1888, and professor in 1897. He has published: 'The Civil Government of Texas' (1898); 'Texas,' in 'American Commonwealths' series (1903).

Garrison, Wendell Phillips, American editor: b. Cambridgeport, Mass., 4 June 1840. After graduation from Harvard (1861), he became literary editor of the New York 'Nation' in 1865. Among his publications are: 'What

Mr. Darwin Saw in His Voyage Around the World' (1879); 'Bedside Poetry' (edited, 1887); the 'Life of William Lloyd Garrison,' his father, with his brother, F. J. Garrison (1885); 'The New Gulliver' (1898).

Garrison, William Lloyd, American reformer: b. in Newburyport, Mass., 12 Dec. 1805; d. New York 24 May 1879. He was apprenticed to a shoemaker, but eventually became a compositor on the Newburyport 'Herald,' an occupation which suited his taste; he soon made himself master of the mechanical part of the business, and when only 16 or 17 began to write for the 'Herald.' His contributions, which were anonymous, were favorably received, and he soon commenced to send articles to the Salem 'Gazette' and other papers, drawing the attention of political circles by a series of articles under the signature "ARISTIDES," with the view of removing the almost universal apathy on the subject of slavery. In 1824 he became editor of the 'Herald,' and some of Whittier's earliest poems were accepted by him, while their author was yet unknown to fame. In 1827 he became editor of the 'National Philanthropist,' the first American temperance journal, and afterward of a journal in support of the election of John Quincy Adams. With Mr. Lundy, a Quaker, he then started at Baltimore the paper called the 'Genius of Universal Emancipation' (1829). The vigorous expression of his anti-slavery views in this last paper led to his imprisonment for libel, from which he was released by Mr. Tappan, a New York merchant, who paid his fine. He now prepared a series of emancipation lectures, subsequently delivered in New York and other places. He returned to Boston, and in 1831 started 'The Liberator,' without capital or subscribers, a paper published weekly with the aid of one assistant and a negro boy, and with which his name is inseparably associated, and which he carried on for 35 years, until slavery was abolished in the United States. In 1832 appeared his 'Thoughts on African Colonization,' and in the same year he established the American Anti-Slavery Society. For several years the mail brought hundreds of letters to Garrison, threatening his assassination if he did not discontinue 'The Liberator'; the legislature of Georgia offered a reward of $5,000 to any one who should prosecute and bring him to conviction in accordance with the laws of that State; in 1835 he was severely handled by a Boston mob, and the mayor of that city was constantly appealed to from the South to suppress his paper. In spite of all, he successfully persevered. In 1833 he visited Great Britain, and again, in the furtherance of his anti-slavery opinions, in 1846 and 1848. The diverging views of the anti-slavery party, as to whether a political platform should be adopted, and as to the voting and speaking of women, rent the body for a time, but on 1 Jan. 1863 Lincoln's proclamation of freedom to the slaves as a military measure placed the civil struggle on an anti-slavery basis. In 1865, when Garrison's labors had been completely successful, and after the total abolition of slavery in the United States, his friends presented him with the sum of $30,000 as a memorial of his services.

A bronze statue has been erected to his memory in Boston. Some 'Sonnets and Other Poems' by him were published in 1847, and 'Selections from Writings and Speeches' in 1852. See Johnson, 'William Lloyd Garrison' (1882); 'William Lloyd Garrison: the Story of His Life,' by his children (1885–9); and poems to his memory by both Whittier and Lowell. The reformer's character, as revealed in the accounts of his life, shows his great humanitarian schemes to have been the inevitable outcome of a sensitive conscience, a humane spirit, and an overpowering sense of justice.

Garrote, ga-rŏt', a mode of punishment in Spain by strangulation, the victim being placed on a stool with a post or stake (Spanish, *garrote*) behind, to which is affixed an iron collar with a screw; this collar is made to clasp the neck of the criminal, and drawn tighter by means of the screw till life becomes extinct. This word, with the spelling *garrotte,* has of late years become naturalized in Great Britain and the United States as a term for a species of robbery effected by suddenly springing upon and throttling the victim, and stripping him of his property.

Garrupa, ga-roo'pa, the Spanish name, in the West Indian region adopted as generic, and also corrupted into "grouper" of the great black jewfish (*Garrupa nigrita*). See JEWFISH.

Garter King-of-Arms, the head of the heraldic establishment in England, consisting of three kings-of-arms — Garter, Clarencieux, and Norroy, and the herald of the military order of the Garter. The office of garter king-of-arms was instituted by Henry V. in 1417. The duties of the garter king-of-arms are principally to grant heraldic supporters, to arrange funerals, and to present the order of the Garter to foreign princes.

Garter, Order of the, the highest and most ancient order of knighthood in England. Two stories are told of its origin. The first is that Richard I. at the siege of Acre caused some of his officers to tie leather thongs around their legs as a distinction. The origin of the order is, however, generally attributed to Edward III., and the legend runs that the Countess of Salisbury having dropped her garter while dancing, the king restored it after putting it round his own leg, amid the jesting of courtiers, with the words, *Honi soit qui mal y pense* —"Shame be to him who thinks evil of it." The date of the foundation or restoration by Edward III. of the order is not exactly determined; 1344 is given by Froissart, while other authorities, founding cn the statutes of the order, assign it to 1350. In the former year it appears that a festival was held, and a society or company instituted, called the Company of Saint George, with the design of furnishing soldiers of fortune to assist King Edward in asserting his claim to the crown of France, but it seems probable that the organization of the order as an order of chivalry was completed in 1350. The statutes of the order have been repeatedly revised. The order is said to have been founded in honor of the Holy Trinity, the Virgin Mary, St. Edward the Confessor, and St. George of Cappadocia, its special patron. Until the reign of Edward VI. its common title was the Order of St. George, which it still bears, besides that of the Garter. The original number of knights, 26, including the sovereign, its permanent head, is still retained, except that since 1786 princes of the blood are

admitted as supernumerary members. The order is frequently conferred on foreign sovereigns. The vestures and insignia of the order are: The emblem of the order, the garter, a dark-blue ribbon edged with gold, bearing the motto, and with a buckle and pendant of gold richly chased; worn on the left leg below the knee; the mantle of blue velvet, the length of the train distinguishing the king; the surcoat and hood of crimson velvet, the hat of black velvet, with plume of white ostrich feathers, having in the centre a tuft of black heron's feathers, and fastened to the hat with a band of diamonds; the collar of gold consisting of 26 pieces, each in the form of a garter, with the badge of the order, called the George, pendent from it — a figure of St. George on horseback fighting the dragon — the lesser George being worn on a broad blue ribbon over the left shoulder. The star, formerly only a cross, is of silver, and consists of eight points, with the cross of St. George in the centre, encircled by the garter. A star is worn by the knights on the left side when not in the dress of the order. The officers of the order are the prelate, the Bishop of Winchester; the chancellor, the Bishop of Oxford; the registrar, Dean of Windsor; the garter king-of-arms, and the usher of the black rod. There are a dean and 12 canons, and each knight has a knight-pensioner.

Garter-snake, or **Grass-snake.** Names given in the United States to several small striped harmless serpents of the genus *Eutœnia,* especially *E. sirtalis,* which abounds in all temperate parts of the continent from Guatemala to Canada, and is exceedingly variable. This species varies in color from light-green through olivaceous to black, marked by three stripes, but only the one along the spine is well defined, those on the sides being often obscure, broken, or altogether absent. The spaces between these may be spotted in double rows, or not at all; and the belly, usually light greenish-blue, may be darker, almost to blackness. Some varieties have a metallic lustre. The ordinary eastern specimens are olive-brown, with dull spots and stripes. It is everywhere abundant, frequenting grassy meadows, farm-fields, roadsides and gardens, where it searches for mice as the principal part of its food, but it eats insects, small toads and frogs, and the eggs and young of birds whose nests are on or near the ground, for it is not a bold climber. It is abroad by day as well as by night, and itself forms the prey of such larger snakes as the blacksnake and king-snake. In the West it eats all the young gophers and ground-squirrels it can get, and in these habits commends itself to the protection of agriculturists. These snakes are extremely active and swift, as they must be not only to capture their prey, but to avoid being caught by the larger blacksnakes, king-snakes, and the like which pursue them. They swim well and hide clearly in water, and in many habits, as in structure, resemble the water-snakes (*Natrix*); and like them they are pugnacious, and quick to bite when handled, but their teeth are minute and the bite, of course, quite harmless. Their abundance is due to these qualities, not only, but even more to their great fecundity, 25 to 40 young in a season not being an uncommon product for one mother, and an instance of 80 is recorded. These are born alive, in early warm weather, and are able to care for themselves from the start, but the mother remains near them and protects them vigorously for some time. When cold weather approaches, these serpents seek underground retreats, such as old gopher-holes, and there often gather in large numbers which hibernate entwined together in a mass; mating takes place at this season. The skin is usually shed in the spring, by creeping through some crevice and scraping off the old hide, which peels backward from the head.

Of the score or more of species the greater number are Mexican and Central American; and some are known by very few specimens. The beautiful slender ribbon-snake (*E. saurita*) of the southern States is chocolate in color with three narrow distinct stripes, and has highly aquatic habits. The common species of the plains region (*E. radix*) is peculiar in its fondness for fish, catching them constantly in the pools and seizing every dead one cast on shore. A similar fish-loving species is the subtropical *E. macrostemma,* which appears in the talons of the eagle in the coat of arms of Mexico. The common species of California is *E. elegans.* In the southern part of that State occurs a rare form (*E. infernalis*), sometimes wholly black, save a yellowish throat. For the identification of the various species of this wholly American group the reader should consult Cope's 'Crocodilians, Lizards, and Snakes of North America,' published by the Smithsonian Institution in 1900.

Gary, Elbert H., American financier: b. Wheaton, Ill., 8 Oct. 1846. He was graduated at the law school of Chicago University in 1867; admitted to the bar of the Illinois supreme court the same year, and to that of the United States Supreme Court in 1878. He early applied himself to the practice of corporation law, and became general counsel for a large number of railroad and industrial corporations. It was largely through his legal work that his talents as an organizer of large industries first came into recognition. He retired from law practice in 1898 to become president of the Federal Steel Company, which in 1901 was merged into the United States Steel Corporation, he then being chosen chairman of its finance committee.

Gary, James Albert, American statesman: b. Uncasville, Conn., 22 Oct. 1833. He was educated at Allegheny College, Meadville, Pa. In 1861 he became a member of the manufacturing firm of James S. Gary & Son, and in 1870 succeeded his father as head partner. He was defeated as Republican candidate for governor of Maryland in 1879; and was postmaster-general in 1897–8, when he resigned.

Gas. See Critical Point of Temperature; Gases, General Properties of; Gases, Kinetic Theory of; Gasometric Analysis.

Gas and Gas Making. Illuminating gas, generally speaking, is the aeriform product of the destructive distillation of a liquid or solid hydrocarbon, in some instances diluted by the admixture of other combustible gas or gases. Practically all the illuminating gas manufactured throughout the world is made from bituminous coal, or petroleum, or some of the products of

the fractional distillation of petroleum. The gas made from petroleum or its products, and known as oil gas, has a very high candle-power value, and is generally mixed in the process of manufacture with hydrogen and carbonic oxide gases. The mixture is known as water gas. Upon the relative amount of hydrocarbon gas in the mixture will depend the candle-power of the final product. Gas made from bituminous coal is known as coal gas.

In the early days of the industry practically all the gas produced was from bituminous coal, but experiments were made with wood, rosin, and tar, all of them capable of producing illuminating gas, but not as satisfactorily or as economically as coal. The original works at Baltimore were constructed to make tar gas, but the attempt was a total failure, both in convenience to the consumer and profit to the manufacturer. In New York the first attempt was with oil gas, but as this was found too expensive, rosin was substituted, but subsequently abandoned, and coal used. In the Southern States pine wood and rosin have been used. When gas was first introduced its use was confined to shops and factories, a feeling being prevalent in the minds of owners of houses that it was dangerous, and productive of fires. Several delegations of citizens passed resolutions and signed memorials to various legislative bodies protesting against its use.

Water gas was first produced commercially by a Frenchman, Tessie du Motay, about the year 1865. About the same time an American, Prof. T. S. C. Lowe, who had won fame as an aeronaut during the Civil War, was experimenting in the manufacture of gas by the dissociation of steam in contact with incandescent carbon. The result of the operations of du Motay and Lowe was the development of the water gas systems which bear their names — the cupola-retort system of du Motay and the generator-superheater system of Lowe. These are the most important of all the inventions affecting the manufacture of gas up to this date. The experiments of du Motay as well as of Lowe were carried on in the United States, and the development of the water gas system is entirely American.

In all the processes of the du Motay type, the non-luminous gas is generated in cupolas, mixed with oil vapor, and passed through externally heated retorts, for the purpose of gasifying the oil vapor. The gases thereafter being condensed and purified, as are coal gas and water gas produced by other methods. The Lowe process, covered by patents dated 1872 and 1875, may be regarded as the basis of the modern water gas system. It covers, broadly, the use, in connection with a generator, in which non-luminous gas is made, of a superheater, or oil gasifying chamber, fired by internal combustion, the combustible being the carbonic oxide gas formed during the process of "blowing up" — that is, during and from the passage of air through the fuel in the generator. This air is blown through the fuel, hard coal or coke, at a high velocity, for the purpose of raising the fuel to a condition of incandescence fitting it to dissociate the steam admitted during the gas making period. The Lowe process further covers the introduction of oil, or other hydro-carbons, into the non-luminous gas, and the gasifying of the oil by passing through the previously heated superheater.

In the manufacture of gas from bituminous coal there are produced the so-called by-products, coke, tar and ammoniacal liquor, each of which finds a market, either in the raw state or worked up into other products for use in the various arts and manufactures. In the manufacture of so-called water gas, there is but one by-product, and that of minor importance, known as "Water Gas Tar." Its quantity and value depend in part on the kind of oil used in the manufacture of the gas, and in part on the care and intelligence with which the gas generating apparatus is operated. The tar contained in either coal gas or water gas exists in the form of a mist of small drops and vesicles, and is removed, in part by cooling and in part by rubbing against rough surfaces, or impinging against plates. This process is known as "condensation." The tar removed from 1,000 feet of coal gas is approximately one and one quarter gallons; the amount removed from a 1,000 feet of water gas varies between wide limits. It may be as much as one gallon. It is generally much less. The amount of ammonia that may be recovered from 1,000 feet of coal gas is approximately one half pound of ammonia gas.

Illuminating gas, whether made from coal or petroleum, contains certain impurities which must be removed before the gas is fit for consumption, or before it can yield the highest possible candle-power per foot of gas burned. These impurities are ammonia, which is present in coal gas, and sulphur compounds, which are present in both coal and water gas. Carbonic acid is also present in unpurified coal and water gas. It is of little importance, having no deleterious effect, beyond slightly reducing the illuminating value of the gas. It may be removed from the gas or its effect on the illuminating value compensated by the use of an enriching material, or it may be ignored. Ammonia is removed by bringing the gas into intimate contact with water, the water being applied either by a spray or a wetted surface of some so called scrubbing material, which may be coke, brush, thin rough sawn boards or other material having a large surface per cubic foot of space occupied. The amount of water required per unit of ammonia removed depends upon the temperature of the water and the intimacy of the contact between the water and the gas.

Various forms of apparatus for the removal of the ammonia gas are in use, but all depend upon the principle that cold water absorbs many times its volume of ammonia gas. The process of removing the ammonia is called "scrubbing." In the process of purification from sulphur compounds, slaked lime may be used. It is placed on wooden grids in a closed box, the gas being permitted to enter from the bottom and pass upward through the lime. Through the affinity of slaked lime for sulphuretted hydrogen this impurity is removed, and the sulphide of lime so formed has power of combining with other of the sulphur compounds in the gas. The slaked lime also removes whatever carbonic acid may be in the gas. The more general practice is to remove sulphur compounds by the use of iron oxide mixed with small shavings, or planer chips, and exposed to the gas in the manner described above in referring to purifi-

cation by lime. The active purifying agent in this mixture, which is called "iron sponge" or "iron mass," is hydrated ferric oxide of iron — $Fe_2O_3, 3H_2O$. It possesses the property of combining with sulphuretted hydrogen, but has no affinity for other sulphur compounds. After it has been a time in use, however, it contains considerable free sulphur, which has the power of arresting some sulphur compounds other than sulphuretted hydrogen. An advantage in the use of "iron sponge" for purification is, that after it has removed from the gas all the sulphuretted hydrogen which it is capable of absorbing, it will, upon exposure to the atmosphere, absorb oxygen, giving up the sulphur, which remains in the mass as finely divided sulphur mixed through the iron sponge. The mass, having been thus thoroughly re-oxidized by this exposure, may be used again, and so repeatedly, until the amount of free sulphur in it is equal to from 40 to 50 per cent of the whole material. It is then of no further value for gas purification, but because of the large quantity of sulphur and because of its containing a considerable percentage of the ferro-cyanides, it finds a market with manufacturers of sulphuric-acid and other chemicals.

Lime, after use in purifying gas, is of no further value and must be removed from the works or used as filling. This process of removing sulphur compounds is called "purification." When gas has been purified as above, it is passed through a large meter known as the "station meter," and thence into a storage holder, and is ready for distribution.

The first step in the manufacture of coal gas is to subject the coal to a high temperature. The coal is placed (technically called "charging") in retorts which may be made of fire-clay or of iron, but are almost universally of fire-clay, and closed, except as to one outlet for the gas. From this outlet the gas passes through what are known as stand-pipes to what is known as a hydraulic main, where the gas from all the retorts mixes, passing thence to the condensing and purifying apparatus. The temperature to which the coal is subjected varies, but it is generally recognized that it is economical to have this temperature as high as is consistent with maintaining the integrity of the retorts and the enclosing furnaces. The retorts are supported by means of blocks of fire-clay in a structure technically called a "bench," and heated by means of a fire, ordinarily of coke, built in a furnace below the retorts. In modern practice the retorts are heated to what might be called a bright cherry red, and about four hours are required to drive the gas from the coal. When the gas has been driven from the coal, the remaining coke is drawn from the retorts on to the floor, or into some form of conveying machinery, collected, and removed to the yard for storage and sale, except that enough is drawn from the retorts directly into the furnaces to supply fuel for the distillation of the coal.

The construction of retorts and enclosing furnaces, with the pipe connections from the retorts to the hydraulic main, is shown, in elevation and in vertical section, in Figures 1 and 2.

Figure 1 is an elevation of what is technically known as a "bench of fives" — that is, a furnace containing five retorts. AA are the retorts, which are ordinarily D shape in vertical section, 9 feet in length and approximately 26 inches in width, and approximately 16 inches in height. Attached to the front end of each retort is a so-called "mouth-piece" which is closed gas-tight by a lid. It is cast iron.

Attached to the mouth-piece is a so-called "stand-pipe," B, which conducts the gas, as generated, from the retort into the "hydraulic main," C. This hydraulic main extends the entire length of the "stack," which is the name applied to a number of benches built adjacent to each other and within one brick structure.

The process of operation is as follows: A fire is kindled in the furnace D, Figure 2, and the products of combustion, arising from the fuel, pass around the retorts, heating them to a bright cherry red. When this temperature has been reached, coal is thrown into the retorts, the charge varying in weight with the size of the retort. A large retort may take a charge of 350 pounds. The coal having been thrown into the retort, the lid is closed. The heat destructively distills the coal and the gas so produced passes out through the mouth-piece and stand-pipe into the hydraulic main. It will be seen, from the arrangement of the hydraulic main, that the gas passing from the stand-pipe bubbles through the water in the hydraulic main, the presence of the water preventing the return of the gas when the lid is again opened to draw out the coke resulting from the distillation of the coal, and to throw in a new charge.

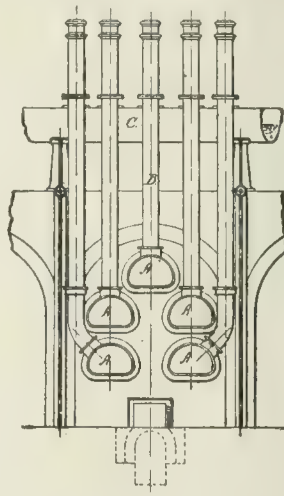


Fig. 1.

There are many forms of retort settings. In the more modern type the retorts are heated from what are known as regenerative furnaces, that is, furnaces which are worked at a comparatively low temperature and whose products of combustion contain a certain proportion of hydrogen and carbonic oxide, due to the introduction of steam below the fuel bed. These products, passing through ports to the chamber containing the retorts, meet there an incoming stream of air, which has been previously heated in flues, brought to a high temperature by the passage of the escaping chimney gases, through similar flues, parallel to and separated by a thin wall from the air flues. The furnace gases and the air combining in the retort chamber pro-

duce a very high temperature. The cuts illustrate the simpler form of retort setting and are given as being typical and easily understood, and not as showing modern practice.

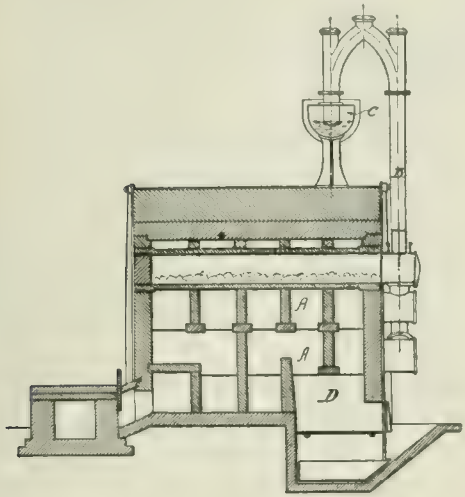


Fig. 2.

From the retort the gas passes to an exhauster, which is a form of gas pump, designed to draw the gas away from the retorts, and force it through the condensers, scrubbers and other apparatus and into the holder, thus reducing the gas pressure that would otherwise exist in the retorts. The operation of one type of exhauster will be readily understood from a reference to Figure 3, which is a cross-section of an exhauster.

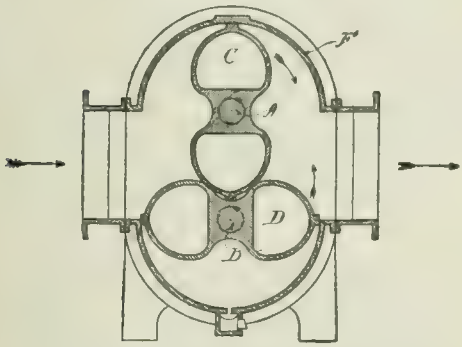


Fig. 3.

F is a cast-iron case, consisting of two half cylinders, of equal diameter, separated by a rectangular prism, and with flat ends. The moving parts consist of two impellers, C and D, keyed to the shafts, A and B, and so set in the case that the axes of the corresponding shaft, impeller and half cylinder, coincide. The impellers are so shaped that as they rotate each is always in contact, at some point, with the cylindrical portions of the case, and at the same time in contact with the other impeller, while the ends are practically in contact with the ends of the case. The shafts are supported by bearings on the case, and connected with each other at each end by two gear wheels, one on each shaft, of the same diameter and with an equal number of teeth, so that the relative position of the impellers is always the same at the same point in any revolution. The lower shaft is extended at one end and provided with a belt pulley, or connected direct to an engine on the same bedplate as the exhauster.

The action is as follows: Motion being imparted to shaft B, is transmitted through the gear wheels to shaft A, causing the two impellers to rotate, as shown by the arrows, and by the continual increase in volume of the space on the inlet side and decrease in volume of that on the outlet side, to draw the gas from the inlet and force it through the outlet, the contact between the impellers preventing the gas from passing back between them. From the exhauster the gas goes to the "condenser," a device designed for the cooling of the gas and the removal of the tar.

A simple form of condenser is shown in Figure 4. It consists of a nest of wrought-iron

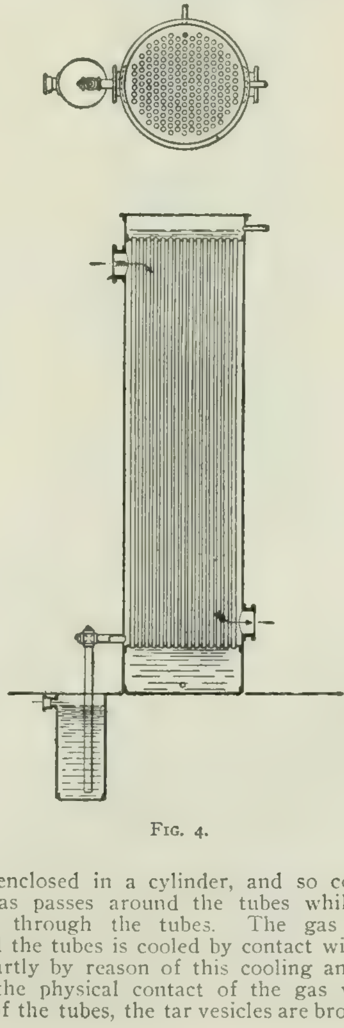


Fig. 4.

pipes enclosed in a cylinder, and so connected that gas passes around the tubes while water passes through the tubes. The gas passing around the tubes is cooled by contact with them, and partly by reason of this cooling and partly from the physical contact of the gas with the sides of the tubes, the tar vesicles are broken, and

combining into drops, run down as drops of tar to the lower part of the cylinder, from which the tar is conducted, through an appropriate pipe, to the well or reservoir, as shown. The gas goes next to the "scrubber," which is designed for the removal of ammonia.

A simple type of scrubber consists of a wrought-iron cylinder, filled with wooden grids, coke or other porous material. Figure 5 shows

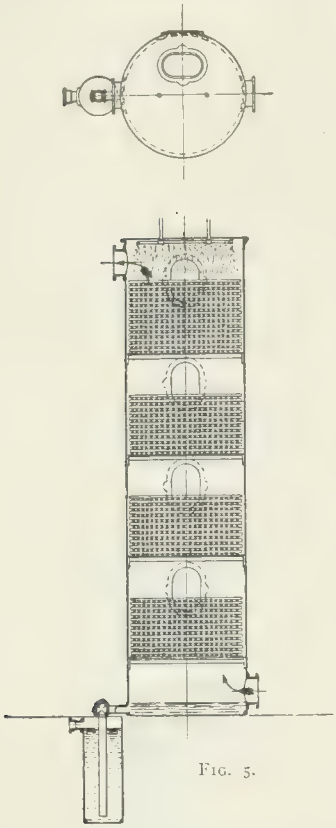


FIG. 5.

a scrubber with grids. The gas entering at the bottom passes up through the filling against a shower of water dripping over the filling. The intimate contact of the gas and water results in the absorption of the ammonia from the gas and also the removal of a certain part of the sulphur compounds and carbonic acid present in the gas, in combination with the ammonia — as sulphide of ammonia and carbonate of ammonia. The scrubber will also remove any traces of the tar that may have escaped from the condensing apparatus.

There are several forms of scrubbers. The above described is the simplest, and except that in some of them the scrubbing material is mechanically moved, so as to come alternately in contact with the water and the gas, the principle of all is substantially the same.

The gas passes from the scrubbers into the purifiers. These are rectangular boxes that are ordinarily built from 3 to 8 feet deep, and of a horizontal section depending upon the amount of gas that it is desired to purify in them. They are ordinarily built in sets of four or six, so connected by pipes and valves that the stream of gas may be made to flow through them in any order desired,— this because it is found economical to pass in sequence through the purifiers and to be able to vary this sequence as the material in the different boxes is more or less charged with sulphur compounds. A section and plan of a box are shown in Figure 6. A is the

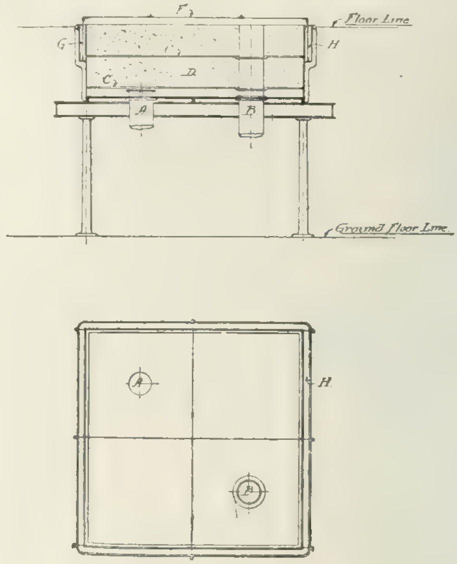
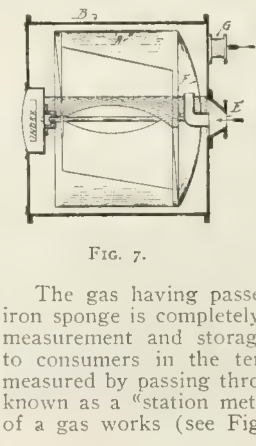


FIG. 6.

gas inlet at the bottom of the box. B is the gas outlet. C are the trays upon which the purifying material D, either lime or iron sponge is placed. F is the lid which is made gas-tight by the insertion of the lip G on its edges into the water-seal H, bolted to and encircling the box. When the lid is on the box the lip G, being in water, will prevent the flow of gas from the box into the atmosphere. When the purifying capacity of the material in the box has become exhausted, which is determined by appropriate tests, the gas is shut off from that box, the lid is raised, and the material is removed — to be carted away, if it is lime, or to be spread upon a brick or concrete floor, for re-oxidizing, if it is iron sponge.



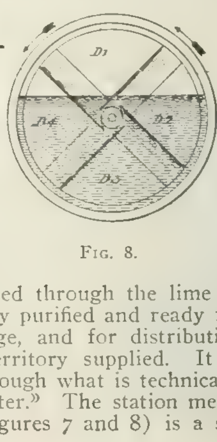


FIG. 7. FIG. 8.

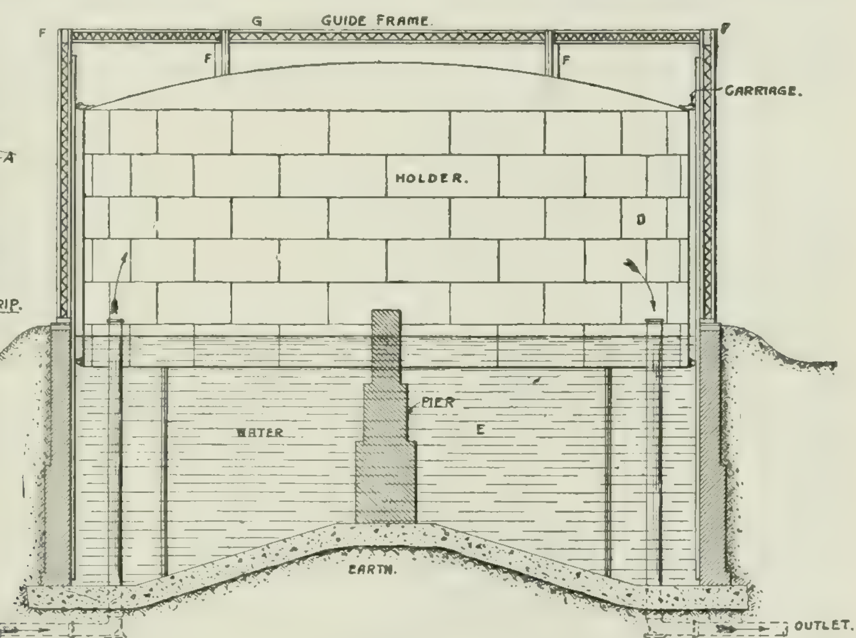
The gas having passed through the lime or iron sponge is completely purified and ready for measurement and storage, and for distribution to consumers in the territory supplied. It is measured by passing through what is technically known as a "station meter." The station meter of a gas works (see Figures 7 and 8) is a so-

called "wet" meter of large dimensions. In principle it is the same as the small wet meters used for measuring gas as sold to individual consumers in those cities whose winter temperature is above the freezing point of water. Figures 7 and 8 show vertical sections of a station meter. It consists essentially of a drum or cylinder of metal, A, horizontally mounted in a metal case, B, so that it may revolve freely on its axis, and divided by wings or partitions into several compartments, D1 to D4, the shape and position of the wings being so designed that, as the drum revolves, each end of each of the compartments so formed, in turn opens above the surface of the water in which the drum revolves, and which fills the enclosing case to about three fifths of its diameter, no compartment having both its inlet and outlet ends above the surface of the water at the same moment. The gas to be measured is introduced through a pipe, E, entering one end of the meter case and compartments filled and emptied is the amount of gas that passes through the meter. This is registered on a dial connected to the drum through an appropriate series of gear wheels. The meter drum revolves because the gas entering is forced by the exhauster into the space between the outer surface and the inclined side of the compartment opening at the moment above the water.

The point of view of Figure 8 is the inlet end of the meter. The drum revolves in the direction of the arrows. Compartment D4, as shown, has its inlet submerged and its outlet open, and as the meter revolves the water enters this compartment, expelling the gas, which flows out of the drum and through the space between the drum and the case to the meter outlet, G. Compartment D1 is full of gas with both inlet and outlet submerged, the outlet being about to rise above the water. This will happen before D4 is entirely emptied of gas. D2 is filling with gas,

CUP AND GRIP.

FIG. 10.



SECTION.

FIG. 9.

rising to above the water line through a hood, F, covering the inlet end of the drum. Into this hood open the inlet ends of the compartments of the drum. As the drum revolves, the inlet end of each compartment in turn rises above the water and receives gas through the inlet pipe and hood. Because the other end of the compartment receiving gas is below the surface of the water, no gas passes through, but all that enters is retained in the compartment until its inlet end is again sealed by passing into the water. At that moment its outlet end rises above the surface, and the water, entering the inlet end as the revolving drum carries the inlet down, forces the gas through the outlet end of the compartment. As one compartment empties, another is filling, and the flow through the meter is continuous, though intermittent as to any compartment. The sum of the contents of the its inlet being above and its outlet below the surface. It is the force of the gas entering this compartment that is giving motion to the meter drum, and expelling the gas from the compartment D4. Compartment D3 is entirely filled with water. It will begin to receive gas before D2 is quite full and while D1 is emptying.

From the station meter the gas passes to the holder or holders, in which it is stored for use at such hours as the demand in the district supplied is in excess of the capacity of the manufacturing apparatus.

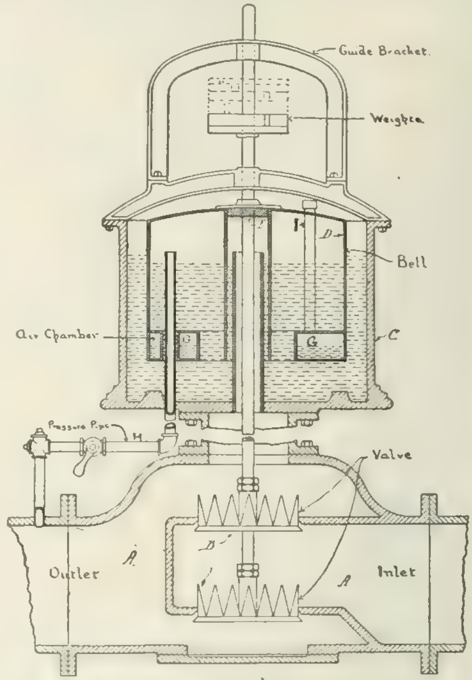
The construction and action of a gas holder, sometimes erroneously called a "gasometer," may be readily understood by reference to Figure 9.

A gas holder consists of a sheet iron cylindrical vessel, D, closed at the top, open at the bottom and floating in a tank, generally built of brick, as in the figure, or of iron, open at the

top and filled with water. The holder is so guided in the tank and along columns FF, standing on the edge of the tank, and connected at the top by girders, that it will rise and fall freely as gas is forced into it or permitted to pass out. The columns and girders are called the "guide frame." To reduce to a minimum the friction produced by the rising and falling of the holder, rollers are attached to its upper and lower circumference. These rollers move on plates inserted into the tank for the purpose, and against the columns above referred to. Gas is admitted to the holder through what is known as the inlet pipe, A, rising above the water in the tank, and opening under the holder. As gas is forced through this pipe into the space between the water and the holder it forces the latter to rise. Gas passes from the holder to the street mains through the outlet pipe, B. As ordinarily used, gas flows continuously into and out of the holder, or set of holders, the excess of make of gas during the day filling them in preparation for the increased demand during the dark hours.

Large gas holders are often made of a so-called "telescopic" type. This expression means that there are within the tank several concentric cylindrical wrought iron sections, one of which only is closed at the top — this being the inner section. The columns in this case have a height equal to the sum of the heights of all the sections. The inner or covered section has as its lower edge a circular trough or "cup" A (Figure 10) which, as the section rises, engages with a similar but inverted trough B, called a "grip," on the upper circumference of the next section. The trough on the lower edge of the inner section being filled with water, a water seal is formed, which prevents the escape of gas. When the holder is down, the cups and grips are under water. Each section, in turn, as it fills with gas, and its lower edge rises to the surface of the water, engages the next lower section in a similar manner. When all the sections are full of gas the volume contained is approximately the capacity of a single section holder multiplied by the number of sections. The main advantage of the system is the small tank depth and ground area per unit of volume of holder capacity. As the gas flows out from the full holder, and the holder sinks into the tank, each section in turn rests on landing stones in the bottom of the tank. The inner section is not permitted to sink so far as to touch the landing stones, but is kept always afloat, except when necessary to make repairs.

The gas leaving the holder to enter the distributing system passes through a district governor, Figure 11. This is a device for establishing and maintaining, at the will of the operator, any desired pressure of gas at the point where the gas enters the street main system. It consists essentially of a valve box, A, inserted in the pipe leading from the holder to the street mains, and containing a valve, B; a cast iron tank, C, placed over the valve box; a sheet iron bell, D, working in the tank, and so fastened to the valve rod, E, that as it rises and falls the valve moves with it, and a connection, H, called the pressure pipe, from the outlet of the valve box to the interior of this bell. The shape of the valve is not important. It may be conical, parabolical or cylindrical, but it must always be so made and so arranged that the upward and downward pressures exerted upon it by the gas will be equal, and so balance each other. In the cut it will be seen that two surfaces of the valve are exposed to the inlet pres-



Non-Automatic Street Main Governor.
Fig. 11.

sure,— one a lower surface and the other an upper surface. Also that two surfaces of the valves are exposed to the outlet pressure,— one a lower surface and the other an upper surface. The pressure on the lower and upper surfaces, it will be seen, balance each other; therefore, they will have no effect on the position of the valve or the bell. There is an annular air chamber, G, on the bell, D, and located beneath the surface of the water in which the bell floats. It is designed to counterbalance the weight of the bell. The exact balance desired is established by pouring water into the air space through the pipe I, rising above the top of the bell. The interior of the bell is connected with the outlet of the governor, through the pressure pipe, H. When, because of an increased consumption of gas along the lines of mains, the pressure on the mains is reduced, the pressure on the interior of the bell is also reduced. This will cause the bell to drop until the opening in the valve connected to the bell is sufficient to pass enough gas to restore the pressure in the outlet, and, therefore, under the bell, which existed before the increased demand for gas occurred. In like manner, if the demand for gas upon the mains is reduced, the pressure in the mains will rise, which also raises the pressure on the interior of the bell — closing the valve until the opening is only sufficient to allow enough gas to pass to maintain the pressure previously existing in the outlet and under the bell. In order to increase the pressure in the outlet, which is important at hours of increased demand for gas, it is sufficient to place weights on the top of the bell, as

shown in the cut. This addition of weight makes a higher pressure necessary at the outlet for any given position of the bell, and, therefore, for any given opening in the valve. To reduce the pressure at the outlet, weights are removed from the bell. It will be seen that it is thus a simple matter to regulate the pressure at the outlet of the governor, and therefore, in the inlet of the street main system, from hour to hour, as the demand for gas varies. It will be impossible with this device to increase the pressure at the outlet of the governor beyond the pressure at the inlet of the governor.

There are governors in use that automatically establish and maintain predetermined pressures in the main system. They are in principle as the governor described, except that by means of an ingenious device they automatically increase or diminish the weight on the bell as the pressure at the governor outlet diminishes or increases.

The sequence of the apparatus above described, and the part each takes in the preparation of coal gas for illuminating purposes, is graphically shown in Figure 12 which represents, in brief, the essential parts of a coal gas apparatus from the retort to the governor, and supposed to be in operation. All auxiliary apparatus, boilers, engines, pumps, conveyors, etc., are omitted from the sketch.

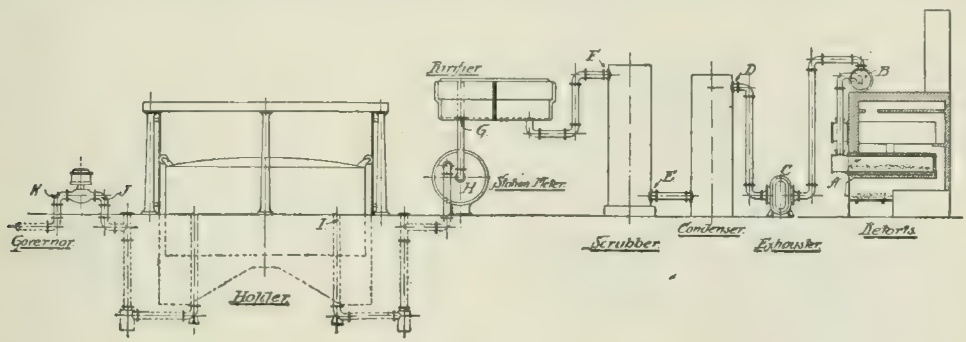


Fig. 12.

At A is the coal being distilled. At B the gas rising from the coal is bubbling through the water in the hydraulic main. At this point the gas contains all the tar and impurities with which it leaves the coal. It is a dark brown color and so dense as to be opaque. Its temperature is approximately 200° F. It consists of hydro-carbon gases, hydrogen, carbonic oxide, water vapor, ammonia, sulphuretted hydrogen and other sulphur compounds, carbonic acid, tar — as a mist of vesicles and small drops,— free carbon and traces of nitrogen and oxygen. At C is the exhauster pumping the gas from the retorts and forcing it through the subsequent apparatus into the holder. At D the gas entering the condenser is practically as it entered the hydraulic main, except that a proportion of the tar and water vapor and all the free carbon have been deposited, due to the cooling of the gas and friction. At E the gas entering the scrubber has parted with practically all of the tar and most of the water vapor it contained when leaving the retort, and with the water vapor there has been deposited a certain amount of ammonia, which the water vapor absorbed as it condensed to liquid. The ammonia absorbed by the water also carried out of the gas a certain part of the carbonic acid and sulphur compounds. At F, the outlet of the scrubber, the gas has practically lost all of its ammonia, water vapor and tar. It is now transparent, and contains of deleterious constituents only sulphur compounds. At G, the outlet of the purifiers, the sulphur compounds have been removed to an extent that renders the gas fit for consumption in closed rooms. The gas may now be used without fear of injury to person or fabrics. At H the gas is passing through the station meter. At I the gas is entering the holder, where it is stored, to be used as the demand of the town or district supplied may require. At J the gas is entering the governor. At this point the pressure will vary and have no relation whatever to the requirements of the district supplied. At K the gas is leaving the governor. At this point the pressure of the gas may be varied in accordance with the demands of the district supplied. If, owing to the approach of evening, or other causes, the consumption of the gas in the town or district increases, the governor, if automatic, will open, thus providing a passage for a larger supply of gas and increasing the pressure at the outlet of the governor. If the governor is not automatic in its action, the pressure may be varied by the addition or subtraction of weights as heretofore described.

The generation and preparation of water gas differs radically from coal gas manufacture, up to the point of entrance to the purifiers; thereafter there is no material difference in the treatment of the two gases.

Figure 13 represents in brief the essential parts of a water gas apparatus, from the generator to the purifier. All auxiliary apparatus, boilers, engines, blowers, etc., are omitted from the sketch.

The Lowe Double Superheater Water Gas Apparatus, which is the modern type of apparatus for the generation of what is known as carburetted water gas, consists essentially of three wrought-iron cylinders connected in sequence, the top of the first cylinder or generator being connected to the top of the second cylinder, or carburetter, which is at its bottom, connected with the bottom of the third cylinder or superheater. The connections in practice are short and like the cylinders lined with fire-brick.

In Figure 13, A is the generator, B the carburetter, and C the superheater. A, B and C are connected with a main blast pipe H and so arranged that air may be introduced in desired quantity and proportion to beneath the grate in A, to the top of B, and to the bottom of C. At the top of C is a stack valve (7) for the exit of the waste furnace gases, and a take-off pipe (8) for the exit of the water gas. When the apparatus is in operation A is filled nearly to its outlet with coke or anthracite coal. B is filled to within a short distance of the connection with A with so-called "checker brick," or fire-brick placed on edge, and with openings between them of from one and one half to three inches. C is similarly filled with fire-brick to within a short distance of its outlet. The fire-brick in B and C are supported on fire tile arches a short distance above the connection from B to C.

The process of making gas in this apparatus may be conveniently divided into two periods, called, respectively, the "blow" and the "run." The blow is the period of introduction of air to gases still contain a small proportion of the unconsumed carbonic oxide and hydrogen, which burn in the air introduced at this point through valve (3) heating the checker work in C to the temperature desired. During the blow the "stack" valve (7) is open and the products pass out of the chimney and so into the open air. When the apparatus has been brought to the desired temperature, which is known from observation through sight cocks conveniently placed, the air is shut off from the three chambers A, B and C, and steam is admitted under the fuel bed A. Oil is then admitted into the top of the chamber, B, spraying down over the checker work in B, and mingling with the carbonic oxide and hydrogen gases formed by the passage of the steam through the fuel in A. The oil is vaporized immediately upon contact with the bricks in the hot chamber, B, and the vapor passing with the gases down through the hot checker brick of B, and up through the hot checker brick of C, is gasified, and the mixture of gases passes out through the outlet valve at the top of C, as carburetted water gas. The

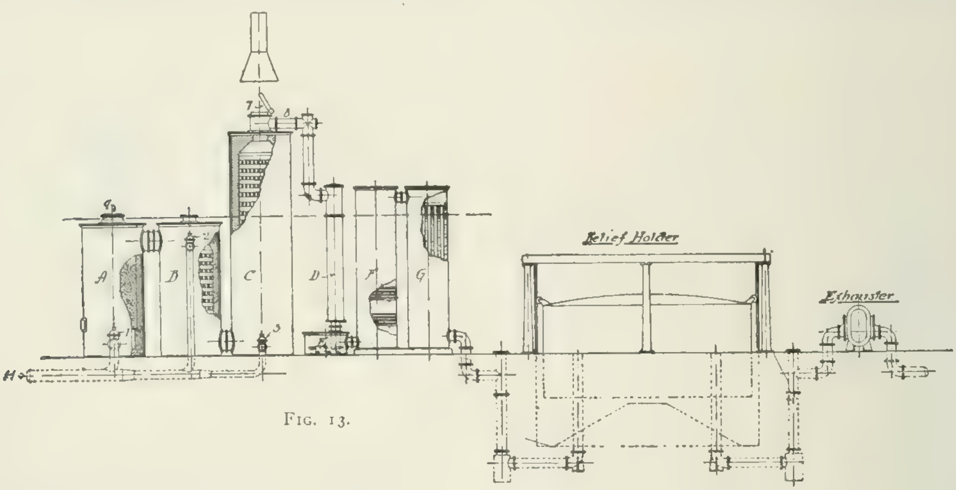


Fig. 13.

the apparatus in the process of heating it to a temperature at which it can economically treat the steam and oil used in the manufacture of the gas. The run is the period of the introduction of steam and oil, and therefore of the generation of gas. Necessarily the blow precedes the run. A power blower maintains a pressure of air on the blast pipe to which are connected the blast valves leading to the apparatus as above described. The valve (1) being opened, air flows into the generator A beneath the grate. Being under pressure this air rises through the fire bed, bringing it to a high state of incandescence. The products of combustion leaving the fuel bed are nitrogen and carbonic acid, with a relatively small proportion of carbonic oxide and hydrogen. Passing into the top of the carburetter B these gases meet an incoming stream of air, admitted through the valve 2, in which the carbonic oxide and hydrogen in part burn to carbonic acid and water vapor. This combustion raises the temperature of the gases and of the checker brick in B down through which the gases pass to the outlet of B and into the bottom of the superheater, C. At this point the stack valve (7) is closed at the moment that the carburetted gas appears, which marks the expulsion of all the blast gases previously contained in the apparatus. Upon the closing of the stack valve the carburetted water gas makes its exit through the outlet pipe D to the wash box E. At this point the gas is brown in color and opaque; it is composed of hydro-carbon gases, hydrogen, carbonic acid, carbonic oxide, sulphur compounds, tar, water vapor, free carbon, nitrogen and oxygen. In E, which has the function of the hydraulic main in coal gas generation, the gas deposits a considerable amount of the tar and free carbon, or lamp black, which it contained and which are due to the gasifying of the oil. From the wash box E the gas passes through the scrubber, F, which in design is similar to the scrubber described above in connection with coal gas manufacture. The scrubber F removes the lamp black and a large proportion of the tar from the gas. These are washed down through the trays in F by a spray of water admitted at the top. The gas passing through the condenser G is cooled to the temperature desired. The last traces of tar may here be removed.

The run is continued until the temperature of the apparatus falls to a point that makes it necessary to re-heat the brick work and the fuel bed. When this temperature has been reached, the oil and steam are shut off. The air valve (1) is opened. The blast rising through the fuel bed in A forces ahead of it the good gas contained in B and C until the judgment of the operator tells him that all the good gas has been forced out of the cylinders, at which moment he opens the stack valve (7).

It will be noted from the above description that the scrubber is before the condenser, which is the reverse of the order in coal gas manufacture. The reason of this is that in water gas manufacture there may be a certain amount of lamp black in the crude gas which must be washed out at the earliest possible moment, and also because there is no necessity of cooling water gas before scrubbing, because there is no ammonia to be removed. The gas leaving the condenser passes to a gas holder, known as a "relief holder," used to equalize the flow of gas to the purifiers, making it uniform from minute to minute, although the process of water gas generation is intermittent, as above described.

From the relief holder the gas is drawn by an exhauster located at the inlet to the purifiers, and from that point on its preparation for use is the same as described above in coal gas manufacture.

After purification, measurement, and storage, the gas, whether coal or water gas, enters the "distribution system," through the governor heretofore described.

The gas leaving the governor enters the street main system. The size of the pipes in this system and their distribution in the streets of the districts supplied depend upon the amount of gas to be delivered in the period of maximum demand, and upon the location, in the district supplied, of the areas of large and small consumption at the time of maximum delivery. The main pipes are ordinarily of 12-foot cast iron lengths, jointed with lead or cement. Wrought iron mains are in use to a considerable extent in some cities.

A "service" is the technical name applied to a pipe laid from the main to supply an individual consumer, the distinction between a main and service pipe being that the main pipe is laid for the general supply of a district or street,—a service pipe being used to connect this main with the premises of a consumer.

A certain amount of water vapor condenses in the mains and services of a gas distribution system, and it is necessary that these should be so laid as to drain to some central point or points, at which this water can be collected in so-called "drips," and the stoppage of mains and services by this accumulated condensation prevented. These drips are cast iron pots, and are connected to the mains at low points in the distribution system. The condensation is pumped from them through a small pipe rising from the bottom of the drip to the surface of the ground, where it is plugged and covered with an iron cap. Observation soon indicates how frequently it is necessary to pump any drip, and at such times a wagon, fitted with a tank, a pump and a hose connection, is sent to the spot and the water is pumped from the drip into the tank on the wagon.

Services are almost universally of wrought iron. It is common practice to provide on a service, at or near the curb line of the street, a cock which may be opened with a wrench inserted through a cast iron box having a lid at

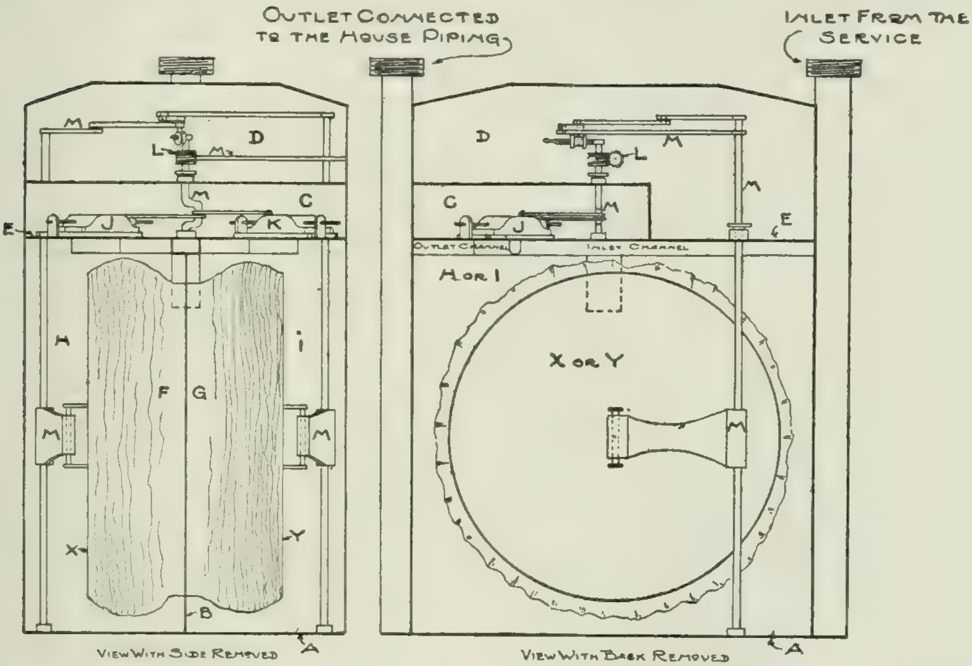


FIG. 14.

the surface of the sidewalk. The purpose of this is to enable the gas company to shut off the supply of gas from any premises in case of fire, or in case of the abandonment of the use of gas on the premises. The arguments for and against the practice of using so-called "service cocks" have persuaded some companies to adopt and some companies to reject them. The service pipe passes ordinarily through the cellar wall to a meter located in the cellar of the premises to be supplied.

The meter used in cold countries to measure the gas supplied to an individual consumer is almost universally of the "dry" type, which, as shown in Figure 14, consists of a tin box A divided into two measuring compartments by a vertical partition, B, these measuring compartments being separated from the superimposed valve and dial compartments, C and D, by a horizontal partition E. The measuring apparatus consists of two leather bellows, F and G, attached to the tin partition, B, and having light tin heads, X and Y, and located one in each of the measuring compartments H and I. The bellows are connected with the valves J and K and the dial gearing L through the rods and cranks M, M.

Gas is measured, as is any liquid commodity, by the alternate filling and emptying of enclosed spaces having a determinable and unvarying capacity. The capacity of the spaces multiplied by the sum of the fillings and emptyings is the volume measured. In the dry meter the gas is measured in the bellows F and G, and in the measuring spaces H and I, surrounding the bellows. Each bellows and each surrounding measuring space is alternately filled with gas, shut off for a moment from any connection with either the inlet or the outlet of the meter, and then opened to the outlet. This filling and emptying is so alternated that there is a continuous flow of gas through the meter, as long as there are any openings for the escape of gas in, or connected with, the house piping connected to the meter outlet. When no openings exist there is no place for the gas to escape and the meter will not move. To understand the action of the meter it is best to follow it through a complete cycle — see Figure 14. Assuming th burners to be all shut off and no leaks to exist in the house piping, the pressure on the outlet of the meter will be the same as on the inlet, no gas will pass, and as it is the passing of gas that moves the meter, it will, under the conditions assumed, be at rest.

In whatever position the bellows and connected valves of the meter may be, and whether the meter be in action or at rest, there is always an opening for the gas into one of the bellows or measuring spaces, and another opening from the other bellows or measuring space into the meter outlet and house piping. If now a burner cock be opened, the gas in the house pipes will begin to flow out through the burner, the pressure in these pipes and in the bellows, or measuring space, at the moment open to the house piping, will fall, and the gas in the service will tend to flow in to restore the pressure. To do this the gas must pass into the meter. Assume that the inlet of bellows F is open. The valves and connections are so arranged that when this condition exists the outlet of F and the inlet of space H will be closed, and the outlet of space H will be open. The gas from the service will then, by reason of the reduced pressure in the house piping and in the space H, force its way into the bellows F, expanding it into the space H, and forcing the gas from the space H through its outlet valve into the meter outlet and the house piping. When the bellows F has expanded to its full working length the rods and cranks connecting it to the valve J will have so far moved the latter that the inlet to the bellows F will close and its outlet open. This change also closes the outlet of space H and opens its inlet. Gas now flows into H, compressing the bellows F, and forcing the gas from it into the house piping. It is clear that at each filling of the bellows F there will be displaced from H and forced into the house piping as much gas as enters F; and that at each emptying of F an equal volume of gas enters H. Thus we have H and F alternately filling and emptying as long as the burner cock is open. It is evident that the gas does not flow through the bellows or through the measuring space. It flows into them alternately, is for a moment shut in, and then as the outlet valve opens flows out. There is, therefore, a definite measuring of each volume of gas that passes the meter. This volume is indicated on the dial by the movement of the rods, cranks and gearing.

In order to insure a continuous flow of gas to the burner, with an intermitting motion to the bellows, each meter is composed of at least two bellows and measuring spaces, so valved that there shall be no moment when there is not at least one inlet and one outlet open. When the burner cock is closed the pressure in the house piping rises in a moment to that in the service and the meter ceases to move. It is evident that when gas is passing the meter it is because the pressure in the service is enough in excess of the pressure in the house piping to overcome the inertia and friction of the moving parts of the meter; and, further, that the meter must cease to move the moment these pressures are equalized. As this difference cannot continue if there is no outlet for the gas, no gas can pass unless an opening exist in the house piping.

Meters are tested for accuracy by passing through them a volume of gas accurately measured in a small gas holder. The law commonly recognizes as accurate a meter that is not more than 1½ per cent "fast" or 2 per cent "slow."

Pure oil gas and acetylene gas are, to some extent, used for illumination.

Oil gas is extensively used for car lighting It is ordinarily generated in retorts very similar to coal gas retorts — the oil being drippec into the retort from the end of a pipe. The gas, after purification, is compressed in cylinders, from which it is drawn into similar and smaller cylinders, located under the car to be lighted. Pure oil gas after compression has an illuminating power of approximately 50 candles.

Acetylene is one of the most interesting of illuminating gases. It is produced from carbide of calcium and water. Carbide of calcium, chemical formula — CaC_2, is produced by the fusion of carbon and quicklime in the heat of the electric arc. When water is poured upon this substance acetylene gas is liberated. The chemical reactions are as follows:

Calcic Carbide + water = Lime + Acetylene

$CaC_2 + H_2O = CaO + C_2H_2$.

When there is an excess of water present the following reaction also takes place:

$CaO + H_2O = Ca(HO)_2$

Quicklime + water = Slaked lime.

Acetylene has an illuminating power of approximately 240 candles. Coal gas has an illuminating power of 14 to 18 candles, and water gas as ordinarily supplied, has an illuminating power of 20 to 27 candles.

Gas produced by the distillation of coal for the production of coke, for industrial uses, has in recent years been conserved, and in some cases is being distributed by local gas companies. This gas is generated in large ovens, generally heated by the combustion of a part of the gas produced, and is treated in the same manner as coal gas generated in retorts, as heretofore described.

The «candle-power» of gas is the amount of light it yields, expressed in terms of standard sperm candles, made under rigid specifications and burning at the rate of 120 grains of sperm each per hour, the gas being consumed through a specified burner at the rate of 5 cubic feet per hour, and depending for its light on the incandescence of some of its component parts, and not, as in the case of the Welsbach burner, on the incandescence of some extraneous substance, subjected to the heat of the flame. Briefly, when it is said that certain water gas is of 25 candle-power, it means that when burned at the rate of 5 cubic feet per hour, through a suitable burner — it would yield 25 times as much light as would a standard sperm candle, made under specifications prepared by the Board of Trade of London, and burning at the rate of 120 grains of sperm per hour.

There are some gases, as for instance acetylene, which cannot be burned at as high a rate as 5 cubic feet per burner per hour without badly smoking. When it is said that acetylene gas is of 240 candle-power it means that when burned at an efficient rate it yields a candle-power that bears the same proportion to the rate at which it is burned as 240 bears to 5.

The calorific or heating value of a gas is the amount of heat generated by the combustion of one cubic foot of the gas, generally expressed in British thermal units. A British thermal unit is the amount of heat absorbed by one pound of water when raised 1° F. in temperature — the temperature being at or near the maximum density of water, or 39.1°. The heating power of gas varies. Acetylene gas has a calorific value of 1,477 heat units per cubic foot. That is to say, the combustion of one cubic foot of acetylene generates as much heat as it is necessary to add to 1,477 pounds of water to raise the temperature of the water from 39.1° to 40.1° F. Natural gas may have a value of approximately 1,000 heat units per cubic foot. Following are analyses of a water gas and a coal gas, giving the calorific value by calculation; that is, the theoretical heating value, as estimated from the heating value of the components of the gas. The value by calculation will be higher than the value developed in a test with the calorimeter, because of some slight losses in the use of the calorimeter.

Gas develops its highest illuminating effect when flowing from the burner at a low pressure. To accomplish this there is located in the burner, at some point below the tip, a so-called «check,» having an opening of less area than the opening in the tip at the point of combustion. Obviously, the gas flowing through the burner at any rate per hour, will pass through the outlet and larger opening at less pressure than is required to force it through the smaller opening in the check.

	Water gas	Coal gas
	23.7 C. P.	Approx. 16 C. P.
C_6H_6	.5	.5
C_nH_{2n}	11.8	4.3
CO	31.3	8.0
H	36.1	47.0
CH_4	12.6	36.0
C_2H_6	2.3	0.0
O	.4	.4
N	2.3	2.2
	100.0	100.0
Calorific value by calculation	669.5 Brit. Ther. Units.	647 B. T. U.

Burners for illumination, excluding the Welsbach and other forms of incandescent burners, are of three general types, the batwing, the fishtail and the argand. (See Gas Illumination, History of.)

Gas pressures are expressed in terms of height of water column. If we say the gas pressure is «one inch» we mean that it is equal to the pressure of a column of water one inch high. If we connect to a gas pipe one leg of a U-shaped glass tube, half full of water, the other leg being open to the atmosphere, the water will fall in one leg and rise in the other until the difference in the water levels in the two legs equal the pressure of gas in the connected pipe. If this difference is one inch we say the gas has a pressure of one inch.

The conception of a system of illumination comprehending a central source, and radiating lines of conduits; the measurement and recording of the service rendered as rendered, and the absolute and immediate control by the served of the time, period and measure of service, was as bold and startling as has occurred in the mind of man. Its fruit, the science and art of gas lighting, has amply justified the conception and has had a leading position among the activities of the wonderful 19th century. Wax and sperm oil were for 50 years its most potent competitors in the field of artificial illumination. Then came the discovery and the utilization of petroleum. Next, and so far last, came the wonderful and adaptable electric light.

Walton Clark,
Gen. Supt. the United Gas Improvement Co., Philadelphia.

Gas-engine is the commonly accepted term for all prime movers which derive their power from the combustion of a properly proportioned mixture of gaseous or liquid fuel and air directly in their cylinder. In the modern engine the combustion takes place after the explosive mixture has been compressed to a certain degree, either by the inward movement of the piston in the power-cylinder, or by the action of a separate compressor which forces the mixture into the working-cylinder in a compressed state. The «explosion» of the compressed charge is in reality a very rapid burning, creating a high degree of heat and a resulting expansive force which causes the piston to be driven forward with an initial or maximum pressure approximating 200 to 250 pounds, and a mean pressure of 80 to 100

pounds per square inch of piston-surface. The power thus generated is transmitted to the driving-pulley or fly-wheels by means of the connecting-rod and crank-shaft. All internal-combustion engines using as fuel hydrocarbons, such as the various kinds of artificial gas, natural gas, petroleum and its by-products (gasoline, benzine, naphtha, distillate), and more recently alcohol, may be classed under the general term of gas-engines.

Development of the Gas-engine.— An investigation of the history of the gas-engine discloses the fact that the idea of employing the expansive force of air and fuel directly in the working-cylinder of an engine suggested itself to the minds of inventors before the advent of the steam-engine. Motors using gunpowder as fuel were proposed by Huyghens in 1680, Hautefeuille in 1682, and Papin in 1688. In 1791 John Barber obtained an English patent on a gas-turbine, in which gas generated from solid or liquid fuels was to be mixed with air and water, and the mixture, after having been ignited, was to exert its force upon a turbine. Another English patent, granted to Robert Street in 1794, describes an oil-engine in which the fuel is evaporated in the cylinder and ignited by a flame after the piston has completed half of its outward stroke.

Lebon in 1801 took a French patent on a double-acting gas-engine, having two pumps for mixing and compressing air and illuminating gas into a reservoir, and from there forcing the mixture into a double-acting working-cylinder, where it was to be electrically ignited. English patents were granted on internal-combustion motors of various construction, and using different means of ignition, to Brown in 1823, Wright in 1833, William Barnett in 1838, Johnston in 1841, Drake in 1842, and Barsanti and Matteucci in 1854. In 1858 Degrand proposed the compression of the mixture in the working-cylinder, and not in separate pumps as before.

Some of the engines mentioned above were actually built, but none were put to commercial use. In 1860 Lenoir in Paris built and placed on the market a one horse-power, double-acting gas-engine having a cylinder three inches in diameter, with a piston-stroke of 5½ inches. This engine had an electric igniter placed in the cylinder-wall at a point opposite half the length of the cylinder, and the electric spark, which jumped constantly between two platinum points, was exposed to the inside of the cylinder alternately on both sides of the piston by the forward and backward movements of the piston itself. Licensed firms undertook the manufacture of the Lenoir engine, which was built in sizes up to 12 horse-power. The fuel-consumption averaged slightly above 100 cubic feet of illuminating gas per brake horse-power hour under the most favorable load.

Two years previous to the appearance of the Lenoir engine, another French inventor, Hugon, had built a gas-engine almost identical with the Lenoir motor, the only difference being in the fact that the mixture entered the working-cylinder after having been compressed. Hugon considered his engine a practical failure, and it was only after Lenoir, through judicious advertising, had scored a commercial success that Hugon again turned his attention to the subject; but soon afterward he constructed a motor which, although built on a much smaller scale than Lenoir's engine, proved to be its superior in fuel-consumption.

The real basis for the gas-engine industry of the present day was formed by the experiments of a young German merchant, N. A. Otto, who in 1861 developed a small experimental engine in which admission of the mixture, compression, ignition, and exhausting the spent gases were accomplished in one cylinder. Failure to realize fully the great promises held out by this engine, due probably to inexperience and practical difficulties, caused Otto to temporarily abandon the further development of this construction. In 1863 he returned to the system indicated in the endeavors of some of his predecessors and, encouraged by the results obtained with his second experimental engine, he, in company with Eugen Langen, a practical engineer of the highest ability, constructed a «free-piston» or «atmospheric» engine, of the vertical type, in which the piston was driven upward by the combustion of the charge and transmitted power to the shaft and fly-wheel on its downward stroke only, when it was actuated by atmospheric pressure. This engine was patented in 1864, and scored its first great success at the Paris Exposition in 1867, where it was brought into competitive tests with a number of French engines built on the Lenoir and Hugon systems. Although noisy in operation, its economy was most pronounced, as it consumed less than one half the quantity of fuel used by the Lenoir, and 40 per cent less than the Hugon engines. In spite of its annoying features, more than 5,000 engines, from one half to three horse-power were placed in actual operation, and some of them can be found in use to this day.

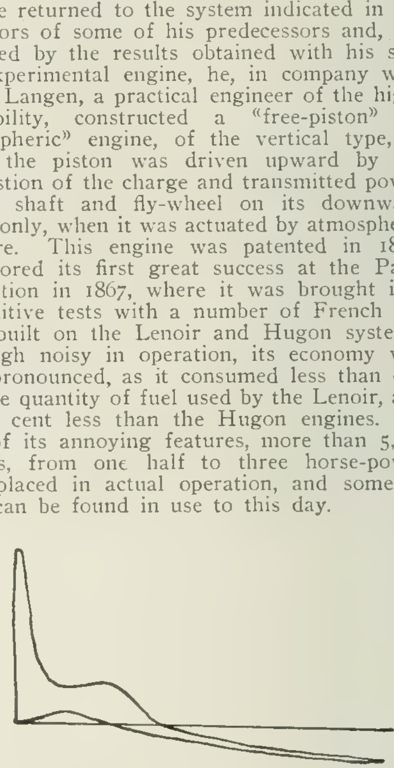


Fig. 1.— Diagram of Otto Atmospheric Engine.

In 1862, one year after Otto built his first model, a French engineer, Beau de Rochas, wrote a paper in which he set forth the advantages to be derived from the system of compressing the charge, before ignition, in the working-cylinder of the engine, and of employing four strokes of the piston (admission, compression, expansion, and exhaust) to complete one cycle of operations. This pamphlet, however, remained unknown until many years later, when it was discovered and published in the course of a patent-lawsuit directed against the claims of Otto and his associates. Beau de Rochas' idea was a brilliant theory, but he had never put it into practical use, and it was due solely to the practical success of Otto that this famous brochure was discovered. In recognition of this fact the four-stroke cycle is generally known to-day as the Otto cycle.

First American Success.— The first successful gas-engine in the United States was built

by Brayton in 1873. It was of the vertical type, with a working and a separate charging cylinder placed above the crank-shaft. A mixture of gas and air in proportion of about 1:9 was compressed to five atmospheres, or approximately 74 pounds per square inch, after which it was admitted to the working-cylinder during the early part of the downward stroke of the piston. Ignition by flame followed after one fourth of the stroke had been completed, and the expansive force thus generated gave an impulse to the piston without increase in pressure. (See Fig. 2). In order to prevent the combustion from reaching back into the chamber

Fig. 2.— Diagram of Brayton Engine.

containing the compressed mixture, several layers of wire gauze were placed into the port connecting this chamber with the working-cylinder, but with indifferent success, as the gauze was too short-lived to be reliable. Actual tests showed the thermal efficiency of the Brayton engine to be about one half that of Otto's "atmospheric" engine, although it was 33 per cent better than in the Lenoir motor. An engine of the Brayton type was built in England by Simon & Beechy, and was by them exhibited in Paris in 1878. It differed from the American model in that steam, generated by the heat of the exhaust-gases, was admitted to the cylinder together with the mixture of gas and air.

The Otto Engine.— The Paris Exposition of 1878 also introduced to the world Otto's new four-cycle engine, which at once proved a success over any other gas-engine built up to that time. Its contruction was very ingenious; it operated smoothly, was practically noiseless, and its fuel-consumption was fully as good as that of the "atmospheric" engine of the same inventor. One of its most ingenious features was the slide-valve used for the admission of air and gas and for the ignition of the compressed charge by means of a gas-flame passing from a jet in the slide-valve cover through the valve into the combustion-chamber. Many of the engines of this type built and sold at that time are in daily successful operation to this hour. It was exhibited at the grounds of the Centennial Exhibition, Philadelphia, in 1878, and became very popular in this country. As a matter of fact, most of the great number of gas-engines built in the United States are based on the Otto principle and vary only in details of construction.

Present Types.— The modern gas-engines may be divided into two classes, that of the four-cycle or Otto engine, and that of the two-cycle engine. The latter type has not been developed to nearly the same extent as the Otto cycle, and commercially has proved far less successful. It has, however, great possibilities and, with proper development, may in time supplant its rivals. To define the difference in operation of the two systems, it may be stated that in the Otto cycle, four strokes of the piston complete one cycle of operations. On the first outward stroke the mixture of fuel and air is drawn into the cylinder by the action of the piston, which in moving forward creates a partial vacuum in the space between the piston and the rear wall of the combustion-chamber. With the inlet-valves open during this stroke, the mixture will naturally flow or be inhaled into the cylinder. On the return-stroke of the piston, with all of the valves closed, the mixture is compressed to a suitable degree, the amount of compression pressure depending on the nature of the fuel used. Just previous to the beginning of the following outward movement of the piston, ignition of the compressed charge takes place. During this stroke the burning charge expands and the resulting pressure is transmitted to the engine-shaft. The last stroke of the cycle, being the second return-stroke of the piston, serves the purpose of expelling the spent gases through the exhaust-valve, which is kept open during this period. As will be seen, two revolutions of the engine-shaft are required to complete one cycle, and only during one stroke or one half of a revolution is power generated and an impulse given to the shaft.

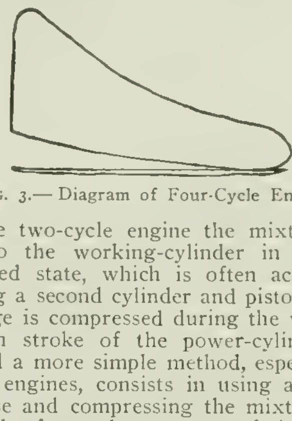


Fig. 3.— Diagram of Four-Cycle Engine.

In the two-cycle engine the mixture is admitted to the working-cylinder in a suitably compressed state, which is often accomplished by having a second cylinder and piston in which the charge is compressed during the working or expansion stroke of the power-cylinder. Another and a more simple method, especially used in small engines, consists in using an enclosed crank-case and compressing the mixture in this case by the forward movement of the working-piston. The operations take place in the following manner: While the engine is running, a charge is admitted through valves or ports opened at the proper time to the compression-cylinder or the crank-chamber, as the case may be, during the back-stroke of the power-piston. During the same time a charge previously admitted to the working-cylinder is being compressed there. On the outward stroke of the power-piston the charge in the compression-cylinder or crank-chamber is compressed and forced into the power-cylinder at the end of this period, while combustion and expansion take place in the working-cylinder. The exhaust valve is opened toward the end of this stroke, and the spent gases are expelled by the incoming new charge. A cycle of operations is therefore completed during every revolution of the crank-shaft, and an impulse given to the shaft at every forward stroke of the piston.

The Six-Cycle Engine.— During the earlier periods of the development of the gas-engine, so-called six-cycle engines were constructed. In addition to the operations taking place in the four-cycle engine, a third revolution of the shaft, or two strokes of the piston, were employed for admitting and expelling a charge of pure air, immediately after the spent gases had been exhausted. By this method of scavenging the combustion-space of the remaining products of combustion, it was expected to obtain more

economical results in fuel-consumption, but these expectations have not been realized. In recent years the construction of six-cycle engines has been practically abandoned.

The Diesel Engine.— One of the most interesting gas-engines of modern times is the Diesel, the construction of which was begun by Prof. Rudolf Diesel about 1893, and is designed to operate on gaseous, liquid, or solid fuels. The first experiments were made with an engine burning coal-dust, and at the present time it is being developed as an oil-engine, using the heavier grades of liquid fuel, such as kerosene or crude oils. Its principle, as laid down by the inventor, involves the production of the highest temperature during its cycle of operations by compression of the air before the fuel is introduced. The fuel is then gradually admitted into the heated air in a fine spray and burned instantaneously. The temperature of the gases is thus kept constant during the period of combustion, and is equal to the temperature of the compressed air before the introduction of the fuel. The early attempts to carry into practice this cycle of operations disclosed the limits to which this ideal system could be practically utilized with present materials and construction. The cycle of operations in the Diesel engine at present is as follows: During the first forward stroke of the piston, air only is admitted to the cylinder at atmospheric pressure and temperature. On the return-stroke this air is compressed to about 500 pounds' pressure per square inch, with a resulting temperature of approximately 1,000° F. Then follows the third or working stroke of the piston, during the first part of which the fuel is admitted and the combustion is maintained at constant temperature, the period of combustion depending on the amount of fuel sprayed into the heated air, which amount is controlled by the governor of the engine according to the load sustained. During the fourth stroke the spent gases are exhausted in the usual manner. In order to inject the fuel into the highly compressed air in the working-cylinder, the engine is equipped with an air-pump and reservoir, the latter being connected to the oil-spraying valve. Both the air-pump and working-cylinder are water-jacketed. The air-pump receives its air from the working-cylinder previous to the end of the compression-stroke and, after compressing it still further, transfers it to the reservoir, where a pressure of from 600 to 800 pounds per square inch is maintained, being in excess of the maximum pressure in the working-cylinder to the extent of 100 to 300 pounds per square inch.

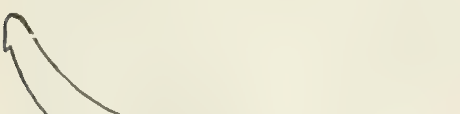


Fig. 4.—Diagram of Diesel Engine.

The accompanying diagram (Fig. 4) shows that there is no explosion, and under full load the top of the card is horizontal, resembling a card from a Corliss engine and showing a distinct cut-off. The Diesel engine is generally of the vertical type, but recently horizontal engines, both four-cycle and two-cycle, have been built in England.

Large Power-Units.— During the early periods of the introduction of the gas-engine its sizes were limited to small power-units, and it was generally considered suitable only for plants requiring not over 50 horse-power. Within the last 15 years, however, the general advance of the gas-engine industry has received a powerful impulse through the construction of large units, up to 1,000 horse-power in single cylinders, and correspondingly larger sizes in multiple-cylinder engines. Double-acting engines of the four-cycle as well as the two-cycle type, in which compression and expansion take place on both sides of the piston working in a cylinder closed at both ends, have aided materially in increasing the size of commercially successful gas-engines. The prevailing price of illuminating gas is prohibitive of its use in these large engines, but this difficulty has been overcome by the use of natural gas, of power-gas made in specially constructed generators from the cheaper grades of coal as well as from wood, and also, in recent years, by employing the waste gases of blast-furnaces and coke-ovens for the purpose of producing power in large engines operating electric generators, blowers, and other machinery. There are to-day, in Europe, a number of blast-furnaces the greater portion of the power required for the operation of which is furnished by gas-engines running on the purified and cooled gases of the high furnace. In the United States the introduction of such blast-furnace gas-engines has been somewhat retarded, but the prospect of their speedy adoption is very bright. As a matter of fact, there is now in course of construction and partial completion a modern steel-plant in the State of New York, in which practically all the power, aggregating approximately 40,000 horse-power, is furnished by gas-engines of large units.

Blast-furnace Gas.— The use of blast-furnace gas in the gas-engine forms one of the most important chapters in its history. The first trials with this fuel were made in 1894 and 1895 and, in order to make a thorough study of the difficulties that had to be overcome, small engines of 10 to 20 horse-power were first installed and operated. The presence of dust in the gas coming from the furnace proved to be the main obstacle, but through the construction of suitable scrubbers and purifiers this difficulty has been successfully remedied, and recent experiments have demonstrated beyond a doubt that the furnace-gas supplied to the gas-engine properly cleaned, contains less dust than atmospheric air under ordinary conditions.

The Modern Gas-producer.— The introduction of gas-engines of large units has led to the development of apparatus for supplying gaseous fuel for producing power at low cost, and the results achieved in this direction have been most gratifying. In the modern gas-producer, which is capable of being installed and operated as readily as a steam-boiler, a suitable gas is generated from practically all grades of fuel, from anthracite coal and coke to lignite, tan-bark, peat, and wood. While the gas-producer requires no more attendance than a steam-boiler, it is far more economical in its efficiency, and less dangerous in operation. It utilizes a greater percentage of the heat contained in the fuel than any other device. Steam-engines become

economical in very large sizes only. The average fuel-consumption in steam-plants between 100 and 500 horse-power varies from $2\frac{1}{2}$ to 4 pounds per brake horse-power hour under favorable conditions. Smaller plants show a comparatively greater fuel-consumption, 10 to 12 pounds per horse-power hour being a fair average obtained in a large number of small sizes under ordinary working conditions. Taking into consideration the degree of efficiency of the steam-boiler and engine, 12 per cent of the heat-value of the steam converted into actual work represents the best results obtained in steam-plants of large size.

The combination of the modern gas-engine and gas-producer, even in small units, shows a considerably higher efficiency. Under average working conditions, 20 to 25 per cent of the energy of the gas supplied to the engine is converted into mechanical work, and under very favorable conditions as high as 30 per cent has been obtained.

The fuel-consumption in a gas-producer and engine-plant of about 100 horse-power will not exceed $1\frac{1}{4}$ pounds of coal per brake horse-power hour, and even better results have been recorded in daily practice. It may be safely stated that the average consumption is never more than one fourth that of a steam-plant of the same size. This being an established fact, proved by years of actual practice, the increasing popularity of gas-power in all branches of industry is easily explained.

Utility of Gas-engines.— If we consider the uses to which the gas-engine is adapted, it becomes apparent that there is practically no limit to the sphere in which it is employed. At the present time it is equally suitable for any purpose for which steam and other sources of energy are applied. While it has not yet been built in units as large as steam-engines, the day is not far distant when gas-engines of 6,000 or more horse-power will be constructed and successfully operated. It is now used in places where no other source of power could be considered. Its principal advantages over steam-power are: (1) Greatly reduced floor-space; (2) complete absence of dirt, smoke, and ashes; (3) readiness for starting without tedious preparation; (4) attendance limited to cleaning and lubricating, which does not require skilled labor; (5) absolute safety from fire or explosion; (6) expense stops immediately as soon as engine is stopped by turning off the fuel.

These features, together with pronounced economy as compared with other sources of energy, have made the internal-combustion engine a favorite prime mover in all parts of the world. It has demonstrated its usefulness not only as a stationary engine, but also for the purpose of propelling vehicles of all kinds on land and water. Marine engines have been built up to 200 horse-power, and it is an interesting fact that gasoline-engines have proved to be the only suitable power for operating the submarine torpedo-boats owned by the United States government and the British admiralty. Steam-power has been tried in this class of vessels, but the heat from the boilers made it impossible for men to live in them for any length of time. Not only do the gasoline-engines now in use in these boats obviate this difficulty, but they are also of superior value on account of the limited space needed for machinery and fuel-storage.

The manufacture of horseless vehicles for pleasure and business purposes has given a powerful impulse to the development of small gasoline-engines used in propelling motor-cars. The readiness with which fuel for these engines can be obtained at almost any point, the limited weight of water and fuel required for their operation, and the extremely low cost of running them have contributed to make them the favorite motor for this class of work.

Considering the great success achieved by the gas-engine during the comparatively short time since its first introduction as a commercially successful motor, its prospects for a future bright and full of interesting developments are of the best. While the steam-engine will undoubtedly maintain its usefulness in larger sizes and in certain branches of our industries, it has found a powerful rival, capable of much greater possibilities, in the modern gas-engine.

L. V. Goebbels,
Otto Gas-engine Works, Philadelphia.

Gas Holder. See Gasometer.

Gas Illumination, History of. The development of gas lighting can properly be placed to the credit of the 19th century. "Spirit of Coal," produced by the distillation of coal, was known as far back as 1739, and the attention of Robert Boyle was called to this substance by Dr. Clayton, bishop of Cork. Its properties were studied and its inflammability and many of its general characteristics were known at this time, although an inflammable gas rising from the surfaces of certain stagnant pools had been noted as far back as 1659.

The first practical application of gas for illuminating purposes was made in 1792. William Murdock, an English engineer, produced gas by the destructive distillation of coal in iron retorts and conducted it for a distance of 70 feet through iron pipes and lighted and heated his house in Redruth, Cornwall. Lebon in 1801 illuminated his house and garden in Paris by gas produced from the destructive distillation of wood. This method of illumination proved a failure on account of the poor illuminating power of the gas. In 1802 Mr. Murdock installed a plant for illuminating the foundry of Watts & Bolton, near Birmingham, and a similar installation was introduced in Manchester shortly after this time.

Street lighting was introduced by F. A. Winzer (afterward changed to Winsor) in 1807 in Pall Mall. Mr. Winsor promoted a company for general gas lighting in 1809, and was granted a charter by Parliament in 1810 for the establishment of the London Gas Light and Coke Company, generally known as the Chartered Gas Company.

In America David Mellville, of Newport, R. I., was attracted by the developments made along the lines of gas lighting in England, and installed in his house, and in the streets in front of his house, the first gas lights used in the United States. This installation was made in 1806, his apparatus, with improvements, was patented in 1813; and a general installation made in several cotton mills and lighthouses.

Baltimore was the first city in the United States to install gas lighting, in the year 1817,

and since that time the growth of the gas lighting industry has proceeded uninterruptedly, for its convenience and economy have been impressed upon the public.

The original promoters of gas lighting encountered many difficulties. At the time of the installation of gas pipes in the House of Parliament, it was stipulated by this body that no pipes should be placed nearer than six inches to any wood-work. Numerous explosions and fatal asphyxiations caused by lack of experience in handling the new substance are recorded. The disagreeable and often injurious odor of the products of combustion of the gas greatly retarded its favor with the public. With the increasing experience of gas engineers, the dangers of explosions and accidental asphyxiations were eliminated. Considerable inventive genius was brought to bear to remove from the room the products of combustion, or to purify the gas for the removal of those constituents which gave the disagreeable products on burning. Several means were proposed for accomplishing these purposes. The most original improvement, and one in use at the present time, was the invention of Clegg, who introduced the use of slaked lime for removing the sulphurous constituents of the gas before it entered the holders. A later development was that of Lanning, who used ferrous oxide mixed with sawdust or wood pulp to make it porous for the absorption of the sulphur constituents. These methods are to-day in general use. Many other methods, of more or less value, have been proposed.

The illuminating power of a flame is derived from the heating of solid particles to incandescence, and the practice of gas illumination can therefore be divided into two general principles.

1. Where the solid incandescent material is supplied by the decomposition of the gas in the process of combustion.

2. Where the complete combustion of the gas is produced by the Bunsen burner, and a permanent incandescing material is supplied as a part of the apparatus.

The latter method is what is generally known as the Incandescent Gas Lighting system. The original developments in gas lighting were made on the first of these principles. The batswing or fishtail flame was produced by releasing the gas through a narrow slit, and its illumination was produced by the incandescence of the solid particles of carbon derived from the decomposing gas in the flame. The Argand gas burner is a modification of the old Argand oil burner, and consists of a ring of small openings arranged near enough together so that the gas flame is in the form of a continuous cylinder, admitting air to the inside and outside of the cylinder.

The Siemens-Lungren system, known as the Regenerative system, consisted in applying to the burner, gas and air which has been preheated.

Prof. Bunsen, professor of chemistry in Heidelberg, designed a burner to produce a non-luminous flame with complete combustion, and to give the maximum heating effect of the gas. This was accomplished by so constructing a burner that it will carry in and mix with the gas a limited amount of air before it reaches the point of combustion. The additional air necessary to produce complete combustion is drawn from the atmosphere surrounding the flame. This type is known as the Bunsen burner.

The experiments of Henry Drummond in 1826, in which he placed a solid stick of lime in the oxy-hydrogen flame, was the first systematic attempt at the development of what is now known as the Incandescent Gas Lighting system. The Drummond, or lime-light, was until recently in general use for the production of very high power lights, especially in theatres and for stereopticon practice, etc. This system, however, was not applicable to the ordinary conditions of gas lighting. A modification of the Drummond light was made by Tessie du Motay, in which he substituted coal gas for the hydrogen in the ordinary Drummond oxy-hydrogen flame. A burner exhibited at the Crystal Palace Electric and Gas Exposition in 1883, by Lewis, was constructed with a platinum mantle suspended over the flame, and designed to produce a high incandescence. This mantle, however, was unsuccesful, owing to the fact that it rapidly deteriorated by the reducing action of the gas. This burner was designed to operate with compressed air.

Clamond about the same time introduced a burner similar to the Bunsen type, in which he placed a mantle made of threads of magnesia. He also introduced an inverted pattern of burner in which a basket or mantle was made of magnesia threads held in a platinum basket. This burner, like the Lewis burner, was operated by compressed air, and was claimed to produce 4½ candles per foot of gas consumed, with a life of from 50 to 60 hours. Mantles in modification of the Clamond type were produced by C. B. Harris, in which he moulded a refractory material into sheets, pressed into the proper shape and perforated in any desired pattern. Attempts have also been made to make a mantle of asbestos or similar non-combustible material, and saturate this with a substance giving high incandescence.

The first commercially successful results accomplished in the field of Incandescent Gas Lighting were made by Dr. Carl Auer von Welsbach, of Vienna. Welsbach's work in this field began in 1880, in Bunsen's laboratory in Heidelberg, where he was studying the rare earths from a standpoint of pure chemistry. His attention was centred on the oxide of erbium. To produce a continuous light for spectroscopic study he saturated a cotton fabric with a solution of erbium, and after burning out the cotton suspended the residual ash in the flame. This produced an intense green light. The idea occurred to Welsbach to utilize this particular method for producing an ash fabric of incandescing material in the ordinary Bunsen gas flame. When this plan was communicated to Bunsen, he replied: "It appears most improbable that the oxides could be made to adhere." Welsbach, however, continued his experiments, choosing not erbium oxide, but oxides which would give a high white incandescence when heated. His researches led him through the entire field of the elements having stable oxides, and certain oxides of the so-called rare earths were found to give the most promising results.

The oxide of lanthanum made a perfect mantle in appearance and produced an intense glow in the colorless flame of a Bunsen burner, but the mantle was found to crumble to a powder within a short time.

Dr. Auer then began experiments with a view of mixing something with the lanthanum which would produce a non-slaking body. In 1887 what is known as the lanthanum-zirconium mantle was introduced. This mantle was made by saturating a closely knit cotton fabric with the proper mixture of zirconium and lanthanum nitrates, burning out the cotton and leaving a network of ash composed of the oxides of zirconium and lanthanum. These mantles gave 12 candle-power per cubic foot of gas consumed, and lasted several hundred hours. To quote Dr. Auer: "The sum of all these results appeared encouraging, and I was audacious enough to pronounce the endeavors of the gas engineers to increase the illuminating power of the open flame, as useless and vain; for it was evident that it was much more economical to renounce the lighting power of the open flame and to transform it into a Bunsen flame, and to get those substances to incandesce in the very hot part of that Bunsen flame, by which method two or three times the amount of light of an open flame could be attained."

The invention was now called to the attention of the public, and Welsbach delivered numerous lectures before the press representatives. The invention was named the Incandescent Gas Light by Mr. Sceps, editor of the *Neue Wiener Tageblätter*. The announcement of the Welsbach mantle was received with various comment, and many prominent engineers refused to take the matter seriously. Welsbach's confidence, however, was not shaken, and companies were formed for the development of the industry and the manufacture of the lighting fluid from the rare earths. The services of Dr. Ludwig Haitinger, an able chemical engineer, were added to those of Dr. Auer in the development of this work.

The increased efficiency of this method of lighting, however, was not what had been expected, and the public refused to take it up. The mantle rapidly deteriorated and required to be rejuvenated. At that time it must also be understood that these mantles were very fragile and in the early stages of the work they were delivered in the city of Vienna by a boy carrying one in each hand, as they would not bear the ordinary handling in transportation. The usual skepticism of the public in regard to new inventions prevailed, and the commercial failure of this enterprise seemed imminent. The Vienna factory was closed and the plant and laboratory sold. The American factory, under the direction of Waldron Shapleigh, was still producing with some success the lanthanum-zirconium mantle.

Welsbach, however, was not discouraged by these drawbacks, and devoted his entire attention to the development and improvement of the mantle. In the early 90's he went before the public with an entirely new mantle, which was composed of 99 per cent thorium oxide and 1 per cent cerium oxide. This mantle gave 24 candles per cubic foot of gas consumed. The present system of manufacture of mantles is entirely in accordance with this last invention of Welsbach's, which consists in saturating cotton fabric with the proper mixture of the nitrates of thorium and cerium, burning out the cotton fabric and tempering the mantle. It is then coated with collodion and packed for the market.

The development of the invention of Welsbach can be said to consist of three distinct stages:

1. The idea of saturating a cotton fabric with a lighting fluid, afterward burning out the cotton and tempering the ash.
2. The formation of the lanthanum-zirconium mantle which gave about 12 candles per cubic foot of gas consumed.
3. The thorium-cerium mantle, which gave 24 candles per cubic foot of gas consumed.

Various improvements have been made in the Bunsen burner and a large number of designs are now on the market; but the general Bunsen principle is strictly adhered to and the present Incandescent Gas Light is invariably produced by applying the incandescing material to the colorless Bunsen burner flame.

To show the wonderful development of the Incandescent Gas Lighting System attention might be called to the fact that the American Welsbach Company manufactured in 1903 20,000,000 mantles; the English Welsbach Company 10,000,000, and the combined Continental companies 60,000,000 to 70,000,000.

The wonderful ability of Welsbach as a chemist and inventor should also be noted, from the fact that the chemicals used in the production of the mantles were very rare and almost unknown, and that he was called upon to find the raw material for the production of these chemicals, and to invent processes for their extraction in a sufficiently pure state for use. All of this work was accomplished successfully after years of patient, painstaking endeavor.

Within the past decade the decorative side of gas-lighting has been all-appealing. The primary idea of gas lighting was illumination, but with a desire for greater comforts and more luxuries in the everyday life has come the desire for decorative effects. Globes, shades and domes are now made in many varieties. Color schemes of beauty are evolved, and artist and artisan combine to lend decorative worth to shape, color and treatment of the globe or shade which is destined to add to the bare illumination of the gas jet or the incandescent mantle.

Table showing efficiency of various systems of gas lighting in use at the present time:

System	Candles per Cubit Foot of Gas Consumed
Welsbach incandescent thorium-cerium mantle	22 to 24
Welsbach incandescent lanthanum-zirconium mantle	11 to 12
Siemens-Lungren burner	5 to 6
Argand flame	3 to 4
Bray burner	3 to 4
Fish-tail flame	1½ to 3

Sidney Mason,
President Welsbach Company.

Gas, Liquefied. The use of compressed ammonia gas has reached large proportions since 1890, and has proven a valuable aid in the preservation of food, the refrigeration of malt liquors, and the manufacture of ice. The introduction of the use of anhydrous ammonia has given great impetus to the manufacture of special machinery adapted to its employment in the departments named. Taken as a whole, its manufacture may be classed as a distinct industry. Although Prof. A. C. Twining, of New Haven, Conn., had in 1850 received a patent for an ice machine using ethyl ether, or other com-

pressed gas, and had in 1855 a machine of one ton capacity in operation in Cleveland, Ohio, and although in 1867, and probably earlier, the ammonia ice machines of Ferdinand Carré were in active operation, this seems to have been the first allusion in the census reports to compressed gases, and no data are there given for them. At the census of 1900 returns were made not only for compressed or liquefied ammonia (known technically as anhydrous ammonia), but also for sulphur dioxide, carbon dioxide, nitrogen monoxide (known technically as nitrous oxide), oxygen, and liquid air, the manufacture being carried on during the census year in 30 different establishments regularly devoted to this business. In addition there were six establishments reported in which liquefied gases were produced as a subordinate part of the product, the major part of the product being in some instances other than chemicals. Besides, one idle establishment was reported. Taking the returns together, it is found that there were 37 establishments devoted to this manufacture, producing $1,220,297 of products and giving employment to 251 wage-earners and $2,185,535 of capital.

Of these establishments 19, employing 181 wage-earners and $1,650,094 of capital, were engaged in producing liquefied carbon dioxide, and the output for the census year amounted to 12,196,061 pounds, of a value of $708,864. In addition, 1 establishment using carbon dioxide in manufacture reported having produced and consumed 165,000,000 pounds of this gas during the year; but, though it was compressed, it was not liquefied for use. There was employed in the manufacture of the liquefied carbon dioxide reported above, 7,027 tons of magnesite, 2,011 tons of limestone, 774 tons of coke, and 4,771 tons of sulphuric acid, and among other products there were obtained 3,095,000 pounds of Epsom salts, 3,278 tons of calcined magnesite, and 5,000 bushels of lime. About 3,500,000 pounds of the carbon dioxide reported came from fermentation or from effervescent springs.

Ten establishments employing 52 wage-earners and $453,328 in capital were engaged during the census year in producing anhydrous ammonia, and the output for the year amounted to 2,443,729 pounds, having a value of $448,157, and there were consumed in this manufacture 2,148 tons of ammonium sulphate, 4,199,708 pounds of aqua ammonia, and 83,402 bushels of lime.

Carbon Dioxide (carbonic acid gas, CO_2).—Carbon dioxide was liquefied by Faraday in glass tubes as early as 1823, through the pressure resulting from the gas being set free from combustion. In 1834 Thilorier operated this method on a much larger scale by the use of wrought-iron cylinders in place of the glass tubes. He discovered that by allowing the liquid to rapidly evaporate the reduction in temperature was so great that a portion of the CO_2 became solid. By moistening this solid CO_2 with ethyl ether he obtained a temperature of —100° C. In 1837 Dr. John Torrey, of New York, liquefied this compound in tubes and applied the liquid to guns as a propellent. In 1844 Natterer invented a pump by which very high pressures were obtained, and through which the liquefaction of carbon dioxide could be better accomplished than by the self-compression method previously used. In all these case when liquefying carbon dioxide, the gas was not only subjected to pressure, but it was also cooled. In 1869 Prof. W. N. Hill, at the United States naval torpedo station, Newport, R. I., proposed the use of liquefied CO_2 in torpedoes. In June-August, 1873, he made more than 500 pounds of the material, and the manufacture was continued at the station at intervals for some years.

In a private communication, from John B. Stobaeus, of Charles Cooper & Co., Newark, N. J., it appears that he began the liquefaction of carbon dioxide on a commercial scale in the United States in July 1884, and put the product on the market. The gas was generated from magnesite imported from Greece, by reaction with sulphuric acid, and the by-product was Epsom salts. The material was sent to the trade in steel tubes weighing about 27 pounds each, and these tubes were fitted with a valve, having a conical seat, which was invented by Mr. Stobaeus. The books of this firm show that 1,188 cylinders, containing 14,256 pounds of CO_2, were produced in 1885, and 10,704 cylinders, containing 128,448 pounds of CO_2, in 1891. The manufacture has since been taken up by others, and in addition to the method used by Mr. Stobaeus the carbon dioxide is now obtained by burning magnesite, by which magnesia is obtained as the by-product; or dolomite, by which a cement is obtained as the by-product; or marble or limestone, by which quicklime is obtained as the by-product; by treating marl with sulphuric acid; and by burning coke. The carbon dioxide issuing from effervescent mineral springs, and that produced in the fermenting tubs during the brewing of beer, is also collected and liquefied. In all of these processes the gas is washed and otherwise purified before compression.

From the data given by Mr. Stobaeus it appears that the cylinders supplied by his firm held 12 pounds of CO_2 each. The American Carbonate Company, of New York, advertise to supply cylinders in two sizes, containing 10 and 20 pounds of CO_2, respectively, representing 600 and 1,200 gallons of gas, the net weight of the cylinders being 27 and 70 pounds. Several of the companies announce that the cylinders are tested for a pressure of 3,700 pounds per square inch.

Compressed carbon dioxide is used in charging soda water, mineral water, cider, beer, and other effervescent drinks. By attaching a charged cylinder of the gas, governed by a proper regulating valve, to a barrel of beer or other beverage the liquid is not only continuously charged with the gas, but by the gas pressure the liquid is forced to the point where it is desired to serve it. By its use the old art of "krausen," which consisted in adding to stored beer, as it was being casked or bottled, some beer in the first stages of fermentation, has been displaced. Carbon dioxide is used in the manufacture of salicylic acid and of many carbonates. It is proposed for use as a medicinal agent by inhalation and in baths; for raising dough in the manufacture of aerated bread; as a refrigerating medium; as a buoyant material in raising wrecks or preventing disabled ships from sinking; and for extinguishing fires, R. Ogden Doremus having found that but 20 per cent of CO_2 in the air of the locality where fire exists is sufficient to arrest the progress of the flames. It has been used by the government as a motive power for automobile torpedoes.

Anhydrous Ammonia.— This material is the chemical substance ammonia (NH_3) in a pure and dry condition and in a compressed and liquefied state, and it is manufactured by the distillation of the ordinary 26° ammonia of commerce in a suitable apparatus. This apparatus, which should be of sufficient strength to stand a pressure of 65 pounds to the square inch, comprises a still, a condenser, three separators, and a drier or dehydrator. The still is heated by a suitable steam coil to a temperature of about 212° F., when the ammoniacal gas, together with a certain amount of water, passes off into the first separator, which latter is usually situated on the top, and forms an upward extension of, the still. In this first separator the greater portion of the watery particles carried over are eliminated by a series of perforated plates, through the perforations of which the gas had to pass, and are returned to the still through a dip pipe. From this first separator the partly dried gas passes through a water-cooled worm in the condenser, and then successively through the two other separators to the drier or dehydrator, where it is passed through a set of similarly perforated plates to those in the first separator, but having small-sized lumps of freshly burnt lime placed upon them, by which any moisture that may still remain in the gas is removed, and the completely anhydrous product can then be passed into the ammonia pump or compressor. It is found advisable to work the still at a pressure above 30 pounds to the square inch, so as to admit of the liquid being raised to a slightly higher temperature than the boiling point of water at atmospheric pressure, without causing the water to boil, the result of this being that the whole, or practically the whole, of the ammonia will be set free, while at the same time the least possible amount of the water will be vaporized and passed over with the ammonia gas.

Or it may be obtained from ammonium salts by heating them with lime and treating the gas as above described. The salt usually employed is ammonium sulphate. Aqua ammonia, or ammonia water, is of different strengths, according to the amount of NH_3 dissolved in it, but the standard strength has a specific gravity of 26° Baumé, and it contains 38.5 per cent by volume, or 26.6 per cent by weight of anhydrous ammonia. Thus 3.76 pounds of 26° ammonia will be required to make 1 pound of anhydrous ammonia. An excellent table of yields of anhydrous ammonia from 26° ammonia is given by Iltyd I. Redwood. The ammonium sulphate or sulphate of ammonia of commerce is reckoned as containing 25 per cent of anhydrous ammonia.

It is believed that some at least of the owners of ice machines produce the anhydrous ammonia that they employ, either in originally charging their machines, or in making good any loss which may take place, but there are no returns on this point. It appears also that there is some anhydrous ammonia imported, the report on "The Foreign Commerce and Navigation of the United States" from the Treasury Department placing this at 14,210 pounds, having a value of $5,870 for the year 1891, but the data for such importations as may have occurred in other years of the past decade do not appear separately.

Although Fourcroy and Vauquelin and, at about the same time, Guyton de Morveau, announced that they had accomplished the liquefaction of ammonia gas, it is believed that, as they had no suitable means for drying the gas, they failed to obtain the anhydrous ammonia. It was first certainly liquefied by Faraday in 1823, and it was not long before it was being produced in considerable quantities. Larkin and Scheffer began the commercial manufacture in St. Louis, Mo., in 1879.

Anhydrous ammonia appears, as stated above, to have first been used for refrigeration by Ferdinand Carré in his absorption machine, but it was not long before it was employed in compression machines of the type invented by Perkins and Twining, based on the refrigerating principle, which was demonstrated by Doctor Cullen in 1755; and although it has had to compete with ethyl ether, carbon dioxide, sulphur dioxide, and air, it is to-day the material which is most largely used in ice machines, and this is the principal use for this substance, though recent researches indicate that other uses will soon be found for it in chemical manufacture and in other arts.

Sulphur Dioxide (sulphurous acid gas, SO_2).— This substance is produced by burning sulphur in air or oxygen, 1 pound of sulphur giving 2 pounds of sulphur dioxide. It was liquefied by Monge and Clouet about the beginning of the 19th century. The liquefied sulphur dioxide is now a regular article of commerce, and is sent into the trade in glass "siphons" and in iron flasks, as being a convenient means of transportation and storage of the substance for use in chemical laboratories and in manufacture. The liquid has found some use in ice machines. The substance is used as a reducing agent, as a bleaching agent, and as a disinfectant. Hardin states that at present (1899) "about 4,000,000 kilogrammes of this liquid are being prepared annually."

Nitrogen Monoxide (hyponitrous oxide, nitrous oxide, laughing gas, N_2O).— This body is prepared by heating ammonium nitrate to a temperature not exceeding 258° C., when the gas is evolved. It is carefully purified, well washed, and then compressed in steel cylinders. This gas was first liquefied by Faraday in 1823. The Lennox Chemical Company began the liquefaction of the gas for the trade at Cleveland, Ohio, in 1883. The exhilarating properties of the gas were discovered by Sir Humphry Davy, who was the first to inhale it, in 1809, and it then received the name of laughing gas. It is now used as an anæsthetic agent in minor surgical operations, especially in dentistry, its use for this purpose having been suggested by Dr. Horace Wells, and it was first applied by him in the extraction of a tooth at Hartford, Conn., 11 Dec. 1844.

Oxygen.— This gas, as commercially supplied in the compressed condition, is produced by heating potassium chlorate mixed with black oxide of manganese. It is sold in the market for use in medicine by inhalation, when it is usually mixed with nitrous oxide, essential oils, and other bodies which are believed to possess therapeutic qualities. Liquid oxygen is not known to be produced commercially except as referred to under liquid air, but it was the first of the so-called permanent gases to be liquefied, this having been independently effected by Pictet and Cailletet in 1877.

Liquid Air.— Atmospheric air is a mixture of approximately 21 per cent of oxygen and 78 per cent of nitrogen by volume, with ninety-four one-hundredths of 1 per cent of argon, about four one-hundredths of 1 per cent of carbon dioxide, and variable quantities of water vapor, ammonia, and other bodies, according to locality and conditions. After 1823, when Perkins erroneously believed that he had liquefied air, numerous unsuccessful attempts were made to accomplish this result, but in 1877 Raoul Pictet and Louis Cailletet, working independently in Switzerland and in France, achieved the result on a small laboratory scale, and it was later repeated by Wroblewski, Olszewski, and Dewar, who improved the methods so as to notably increase the yields, and in 1893 Dewar froze air into a clear, transparent solid. The liquefaction of air on an industrial scale began about this time with the invention of the machines of Linde, Hampson, and Tripler, and later those of Ostergren and Burger, Dewar, Kuhn, Chase, Code, O'Doherty, Johnson, and others.

The methods may be classified as the cascade method of Pictet, Cailletet, Wroblewski, and Onnes; the self-intensive motor method of Siemens, Kuhn, and Johnson; the countercurrent free-expansion system of Linde, Hampson, Tripler, Ostergren, and Burger; and the self-intensive work method of the American Liquid Air Company, known as the Ala system. Emmens states that the principal features of the method to effect the liquefaction of air on a commercial scale were clearly described in the specifications of British patent No. 2064, granted to Charles William Siemens in 1857.

Owing to the complex composition of air, several different products are obtained by its liquefaction, notably liquid oxygen and nitrogen and solid carbon dioxide. Pictet has invented a separator by which these bodies may be rapidly separated for use, and there is thus drawn off at —70° F., solid carbon dioxide; at —290° F., commercial oxygen gas of 50 per cent purity; at —296° F., oxygen gas of 99 per cent purity; at —300° F., liquid oxygen and nitrogen gas of 95 per cent purity; at —310° F., nitrogen gas of 99 per cent purity; at —312° F., liquid air; and at —316° F., liquid nitrogen.

While many commercial uses for liquid air have been proposed, it is not known to be so used at present. It may, however, be now looked upon as a source of oxygen which promotes combustion and enables man to obtain high temperatures and high illuminating power, but it is not yet proved that this method of heating and lighting can compete economically with electricity. Liquid air does enable man to readily obtain low temperatures, which can be usefully employed in chemical operations, and a continually extending use may be looked for in this direction. Elihu Thomson has pointed out that it may find a useful application in increasing the efficiency of conductors of electricity.

Chlorine.— This gas, which may be produced by the action of muriatic acid on black oxide of manganese or by the electrolysis of common salt, is produced commercially abroad in the liquid state, but no returns are made of it in this country. It is used in chemical manufactures and for bleaching and disinfection. It is sent out to the trade in iron cylinders.

Gas, Manufactured, in America. To relate the entire history of the industry of gas-lighting it is necessary to go back no further than the beginning of the 19th century. Moreover, this statement is just as true concerning other countries as it is in relation to the United States, for while William Murdock, of England, and Philippe Lebon, of France, began to investigate the possibilities of manufacturing and distributing illuminating gas distilled from bituminous coal late in the 18th century, it was practically the dawn of the 19th century before these experiments has resulted so successfully as to establish the practicability of the project. As the question as to whether the credit for the discovery of gas properly belongs to Murdock or to Lebon is still unsettled in the minds of scientists it is useless to attempt to discuss it in such a brief review of the gas industry as this must be.

So far as we have any record the first use of illuminating gas in the United States was in 1806, when David Melville, of Newport, R. I., lighted his house and the street in front of his residence with gas made by him upon his premises. This was fully one year before the first public gas-lighting experiments were given in England, although Murdock claimed to have lighted his place in Old Cumnock with gas manufactured by himself, a little less than nine years prior to the Newport experiment. In Melville's case, however, the question of prior invention was scarcely considered. Encouraged by his success in a project that was purely original with him, he continued to improve upon his process until, in 1813, when his apparatus was so nearly perfect that he decided to patent it. A year or two later he undertook his first big contract, which was to light the cotton mill at Watertown, Mass. This being successful he applied his gas invention to the lighting of another mill at Providence, R. I., and, in 1817, he introduced his system in the illumination of lighthouses.

It was from these small beginnings that the present great industry of gas manufacture in America has grown. It was a slow growth at first, but, gradually, as the apparatus for its manufacture improved, and man's knowledge of the physical laws involved became more accurate, it began to show a more rapid increase. The first company regularly established to manufacture gas was chartered in Baltimore, Md., in 1816. In 1822, Boston adopted the gas system of lighting. In 1823, a lighting company was organized in New York, and during the next three years gas was introduced in New York city, Brooklyn, and Bristol, R.I. In 1835, the New Orleans Gas-Light Company was chartered to manufacture the new illuminant, and these were the pioneer companies in the United States. From 1835, however, the organization of such corporations continued with great rapidity, until almost every progressive city in the country was provided with a gas-lighting plant. In 1859, according to the statistical tables prepared by the "American Gas-Light Journal," there were 297 companies in the United States, working with a capital of $42,861,174, supplying a population of 4,857,000, through 227,665 private meters, while the extent of the growth of the industry from

1860 to 1900, which, while they fall below those given in the "Directory of American Gas Companies," have been pretty generally accepted by persons looking for a conservative estimate. According to the census statistics, therefore, there were in the United States, in 1900, no less than 877 gas establishments; their capital invested was in excess of $567,000,000; the value of their products aggregated $75,716,693, of which amount $69,432,582 was received directly from the sale of gas. The figures of the 12th census show an increase of nearly 84 per cent. in the amount of gas sold during the last decade of the 19th century, and while it is impossible to give anything like an authoritative statement of the number of premises at present supplied in all parts of the United States, there is little reason to believe that the estimate which places the aggregate at more than 2,000,000 is an excessive one. Several years prior to the census year it was reported that there were 134,447 premises supplied with gas in the State of Massachusetts, and more than 153,500 premises in the city of Philadelphia alone.

As the Philadelphia gas-works is operated by the city it has records which are open to the inspection of the historian. Moreover, as its history is typical of that of other early plants established to supply gas to the consumer, its story is an excellent illustration of the development of the gas corporations of that day. The first attempt to manufacture gas in Philadelphia was made in 1815. At this time it was proposed to use wood, but the experiments failed. From that day, therefore, the matter was dropped until the winter of 1826-7, when several influential citizens appeared as advocates of a project to erect gas-works and light the city with gas made from coal. Although favorably regarded in many quarters the proposition was defeated owing to the strong opposition of other Philadelphians of high standing, all of whom claimed that the introduction of gas would be dangerous to the life, limb, and health of the people. Unable to overcome such a tide of popular disapproval of the scheme, the project was dropped until 1835, when an ordinance providing for the construction and maintenance of gas-works and the distribution of gas was finally passed. According to the provisions of this ordinance, stock was issued to the amount of $100,000, and it was estimated at the time that the lighting of the entire city would require the operation of some 20,000 burners, each capable of consuming an average of four feet per hour. The plant was so fully completed as to be put into operation in 1836, and, in 1837, 17,000,000 cubic feet of gas was distributed, 6,816 private burners, and 301 public lamps being supplied. Compare this record of the first year's operations with that of the census year, when the sales in Philadelphia aggregated 7,055,559,210 cubic feet, at an average of $.0761 per 1,000.

The story of the development of the New Orleans Gas Company shows a similar growth. In 1830, the company had an output of 7,300,000 cubic feet, at $7 per 1,000; in 1840, the product had increased to 20,075,000 cubic feet, but the price was unchanged; in 1850, the output was 53,562,000 cubic feet, at $5 per 1,000; in 1860, 132,418,000, at $4.50 per 1,000; in 1870, 236,468,000, at $4. The effect of the panic of 1873 was to cause such serious depression in every line of business in New Orleans that gas sales were naturally reduced, so that, in 1880, they amounted to only 230,296,000, at $2.70 per 1,000. The period between 1880 and 1890 saw a change in the candle-power, the gas which had previously been about 16.5 being raised to 33. Thus while the record of sales for 1890 shows a consumption of only 181,497,000 cubic feet, the increase in the candle-power made the total illuminating value of the gas sold in 1890 equal to fully 363,000,000 cubic feet of the gas sold in 1880.

It was in 1837 that seven of the prominent citizens of Cincinnati procured a charter for the purpose of making and selling gas in that city. In 1843, the capital of the company was nominally $100,000, although it is scarcely probable that even so much as half that sum had been expended in building the works and the six miles of mains through which they operated. In the beginning, $3.50 per 1,000 was the price charged for gas in Cincinnati; in 1846, it was reduced to $3; in 1854, to $2.50, and since that time it has enjoyed periodical reductions until the present day, when it is sold at the price of 75 cents per 1,000 cubic feet. On 1 Jan. 1847, the company had 546 meters and 192 public lamps in use, these being supplied through 32,487 feet of main pipe, ranging from two to eight inches in diameter. In New York, the story is a similar one, for while the first company was started with small facilities, to furnish a few thousand meters and a comparatively small number of public lamps, the system had been extended to meet new requirements, until, in 1900, the annual sale of gas in New York aggregated 18,180,821,125 cubic feet, or 27.1 per cent. of the total sale of the entire country. The rate in New York during this census year was $0.905.

In the early days in the history of gas manufacture in America, soft or bituminous coal was practically the only material used. In some sections of the South gas was manufactured from rosin and pine-wood, and, during the War times, when the existence of the blockade made it almost impossible to obtain coal, nearly all the towns were glad to employ these materials in the making of gas. Compared to the old-fashioned whale-oil lamps and the tallow dips, even the wood-made gas seemed like a brilliant illuminant, whereas the best gas of that day — that which was manufactured from the soft coal — bore only a remote comparison to that which is sold at the present time, the soft coal gas having an illuminating value which was approximately not more than from 15 to 17 candle-power.

It was about this time that M. Tessie du Motay, a Frenchman, and Professor T. S. C. Lowe, the famous American æronaut, began their independent experiments in the manufacture of gas by the dissociation of steam in contact with incandescent carbon. The result of these two series of experiments, both of which were conducted in the United States, was the discovery of Du Motay's cupola-retort system, and the development of the generator-superheater system of Prof. Lowe, the latter being the most important of all inventions that had yet affected the manufacturer of gas thus, as may be seen, it was to America that the world

owes the discovery and development of the water-gas system of lighting.

The introduction of the two new systems of gas manufacture was an event of vital importance to the industry. The Municipal Company of New York was the first to construct a large plant under the Du Motay system. By this process non-luminous water-gas was generated in cupolas, carburetted with oil vapor, and passed through retorts externally heated, the gas thereafter being condensed and purified by processes very similar to those of coal-gas and other water-gas systems. Important as this improvement was, it was the Lowe process — covered by patents dated 1872 and 1875 — that was accepted as the basis of the modern water-gas system. It covers, broadly, the use, in connection with a generator in which non-luminous gas is made, of a super-heater, or fixing-chamber, fired by internal combustion, the combustible being the gases which are formed during the process of "blowing up;" that is, during and from the passage of air through the fuel in the generator. The fuel used in this generator is hard coal, or coke. The air is blown through it at a high velocity, which raises the fuel to a condition of incandescence, which fits it to dissociate the steam that has been admitted during the gas-making period. Lowe's process also covered the introduction of oil, or other enriching substances, into the non-luminous gas, and the fixing of this oil by passage through the super-heater. The first attempt to introduce the Lowe system was made at Phenixville, Pa., in 1873. A few months later, the inventor himself erected his apparatus at Conshohocken, Pa., and at Columbia, Pa.

The method which is now used in the making of water-gas is the double superheater, or improved Lowe apparatus, which was developed by the United Gas Improvement Company, the owners of the now-lapsed Lowe patents for the greater part of the country. Of course, many modifications of the two water-gas systems have been made and patented during the past quarter of a century, but none of them have been of so much importance as to deserve special attention, and while the first years of the fight for the introduction of water-gas was waged against the most bitter antagonism on the part of the coal gas interests, the product of the later inventions was so much superior in every way to the old-time coal-gas, that its growth, after it had once obtained a foothold, was very rapid. In 1880 there were less than 90 water-gas plants in the United States — about 75 of the Lowe type and 12 of the Tessie du Motay type, to be as exact as possible — but in 1890 the number had extended to such an extent that there were no less than 260 of the Lowe plants and fully 30 of the Du Motay plants in operation. By that time every city in the United States that could boast of a population of more than 400,000 had introduced water-gas, wholly or in part, while all but six of the cities with more than 50,000 inhabitants had gas made by one of these processes. Since 1890 the ratio of water-gas as compared to coal-gas has further increased until the former now represents fully 75 per cent of the total product of the country. The largest water-gas plants in the United States are the Tessie du Motay plants in New York and Baltimore, and the Lowe plants in Chicago, Boston, Providence, and the 25th Ward Works, in Philadelphia.

The victory of the water-gas interests was due to perfectly logical causes for each of the many arguments which finally obtained for the system such widespread adoption was based upon a demonstrative point of advantage. Its influence upon the mind of the consumer, however, was largely due to its advantage in the matter of candle-power. Whereas the coal-gas averaged about 15 candle-power, the water-gas that is sold is of candle-power varying from 22, which is probably the minimum, to its 35 candles in Pensacola, 33 in New Orleans, and 30 in New York, and with a probable average throughout the country of from 25 to 27 candles. Compare this, from a luminating point of view, with the conditions existing in England, where here are some companies that are chartered to furnish gas of 14 candle-power, and where not over 5 per cent of all the gas manufactured is in excess of 17 candle-power. In its ratio of purity the American water-gas is equally fortunate. The English law, for example, permits 20 grains of sulphur in forms other than sulphuretted hydrogen, and three grains of ammonia for every hundred cubic feet of gas, whereas the average of sulphur per 100 cubic feet of gas sold in the United States is seldom as great as 12 grains, while of ammonia there is only the merest trace. In one long series of analyses, which extended over a period of fully 10 years, it has been shown that the gas manufactured by this particular city contained less than 10 grains of sulphur per 100 cubic feet, and practically no ammonia.

If it had not been for the development of the water-gas process the industry of gas manufacture in American would not improbably have been doomed. The invention of this new system came at a day when the gas manufacturers were already trying to devise means of competing against cheaper oil and the improved oil lamps. A few years later the electrician appeared, and his coming had a most disastrous effect upon gas-making companies and the value of their shares. The introduction of the water-gas system, however, and the development of the improvements which followed its introduction, have been the factors which have enabled the gasman to hold his own. Although in some respects electricity furnishes a more desirable light, the high candle-power of water-gas makes it a cheaper illuminant, unit for unit, than the cheapest incandescent electric lamp. Thus, while the introduction of electric lighting systems has made some inroads into the use of gas for street lighting, and, to some extent, has reduced the sale of gas to the private consumer, practically all of the losses that may be traced to such sources have been offset by the fact that so many other uses have been found for gas besides that of illumination. The gas stove for heating and cooking purposes, the gas-engine, and the many other mechanical devices for the utilization of gaseous fuel are developments of this idea, and this branch of the business has grown so rapidly that fully 60 per cent of all the gas produced in this country is now used for fuel purposes. Then came the Welsbach lamp, the invention of Auer von Welsbach of Vienna,

which made the illuminating power of the best burners from five to seven times greater than before, and this so cheapened gas that it once more placed the gasman in a position where he could compete with the purveyor of electric illumination.

As the American gas business stands to-day it is in every sense of the word a home industry, being one of the domestic industries which is entirely independent of foreign countries for the material which it uses. When the New York Gas Company was incorporated in 1823 it made its first gas from oil; later rosin was used, and, by 1860, it was distilling English coals. During that period most of the companies imported the material from which their gas was made. Most of it came from England. Finally, however, they began to use the product of the American mines and it was soon found that none of the soft coals that could be used for gas-making purposes was superior to the bituminous coals mined in this country. The making of water-gas called for no further importations. In view of the substances from which it is made — anthracite and petroleum — there is no country in the world that can produce better materials than the United States, and while, up to a few years ago, cannel-coal was imported from Scotland and Australia for the enrichment of coal gas, beds of such coal, equal to any in the world, have since been found in the United States. So, too, as to the meters and clay retorts, which were once imported from Europe. Years ago they were supplanted by American-made goods and the gas concerns never had any that gave better satisfaction. During the early years of the gas lighting business — in fact, up to 1870 — lime was the purifying agent used by American manufacturers to the almost complete exclusion of other materials. About 1880, however, the use of oxide of iron was introduced. To-day more than three-quarters of the gas made in the United States is purified by this agent.

To tell the story of the birth and development of the gas industry in America without reference to the municipal ownership and management of gas proprieties would be impossible. Because of the dissatisfaction which was certain to exist in view of the monopolistic privileges enjoyed by some of the companies under their old charters, such things as legislative investigations and judicial injunctions were inevitable. In some places relief has been sought in the adoption of municipal ownership. Of course, it may be admitted that the charters granted during the early days were extremely favorable to the companies. It must be remembered, however, that gas-making was then an untried field and that some inducements were necessary to tempt capital to enter such an uncertain industry. As the result important concessions were offered in the form of exclusive franchises, etc., but since it has been shown that the business is a safe and profitable one legislation has been far more exacting.

Gas, Natural. *Early History.*— Natural gas is chiefly a natural combination of carbon and hydrogen, which is only about 60 per cent as heavy as air, and is highly inflammable. Its existence has been known since the earliest records of the human race as a curiosity. Perhaps the earliest historical record of the use of natural gas is that of the Apollo Oracle at Delphi in Greece, about one thousand years before the Christian Era. The Chinese are credited with the practical application of this fuel to the evaporation of salt brine for centuries.

The fire worshippers on the shores and islands of the Caspian Sea, Russia, and those of Punjab, India, have preserved a continuous flame in their temples, caused by a steady flow of natural gas for centuries. In after years it caused the deadly explosions in the deep coal mines in Europe and America, being known to the miner as fire damp. Its existence in the United States has been known since the first white men crossed the divide and explored the Ohio River watershed, as the Indians invariably conducted them to these natural vents, and, setting fire to them, viewed the effect with a semi-religious veneration. The discovery of vast reservoirs, sealed up in the porous rocks of the United States and Canada, is of recent years. The artesian driller, searching for salt brine, knew of its presence since the first wells were drilled on the western flank of the Appalachian uplift; afterward the driller in search of petroleum encountered it, but by both of these early prospectors it was considered a source of danger and annoyance. It frequently caught fire, causing loss of life and destruction of the drilling outfit by a sudden outburst.

The earliest economic use of natural gas known in the United States occurred in 1821, when it was used for the illumination of the village of Fredonia, N. Y. A well one and one half inches in diameter was drilled to a depth of 27 feet near a noted gas spring and for many years supplied the village with 30 street lights.

In 1838 a water well dug at Findlay, Ohio, encountered such quantities of a foul smelling gas that it was abandoned for the original object. It was subsequently covered up and conveyed to a house near by and utilized for domestic fuel and lights for nearly 50 years.

About the year 1841, natural gas was found in a well near Charleston, W. Va., which also supplied salt brine, from which it was separated and for many years used as a fuel for making salt.

More or less natural gas was developed in the rush to find petroleum in the valley of Oil Creek in the winter of 1859 and the year following.

One of the first attempts to employ natural gas for fuel purposes was at a well drilled at Erie, Pa., in 1868, which was soon followed by many others; these wells were only 600 feet in depth and supplied from one to three families each. Titusville, Pa., enjoys the distinction of installing the first modern equipped natural gas plant, as well as the first well drilled for petroleum. This plant was constructed during 1872, 13 years after the first oil well was drilled by Col. Drake.

During 1873 natural gas was introduced into many of the villages of Butler and Venango counties for light and fuel, being supplied from wells drilled not far distant in prospecting for petroleum. In the year 1875 the first long line (17 miles in length) was built; the pipe used was 6¼ inches in diameter, supplying the natural gas produced from the Harvey well at Larden Mills, in Butler County, Pa., to a large

manufacturing plant known as the Etna Iron Company on the Allegheny River, a few miles above Pittsburg. In the 10 years that followed slow progress was made in the actual use of the known gas wells; many were utterly ruined by pulling the casing and allowing the inflow of water, which gradually sealed up the rock and prevented the flow; this was after a struggle for years. Others were allowed to escape into the air for years. There seemed to be an uncertainty in the minds of all, as to the lasting properties of this natural product.

In the year 1876 the large Haymaker well was drilled in at Murraysville, Pa., and was not utilized until the year 1883, when its product was piped to Pittsburg. By the close of 1883 a number of pipe lines were supplying Pittsburg and the Beaver Valley with natural gas from a number of good gas wells drilled in Washington, Beaver and Butler counties. During May 1885, the first natural gas well from the deep Speechly sand was drilled, seven miles south of Oil City, Pa. During the same year the remarkable deposit of natural gas in the Grapeville pool, near Greensburg, Pa., was also found.

These numerous natural reservoirs at this period with their initial pressure seemed to convey the impression that it could be found in almost any locality and that the supply was practically inexhaustible.

In 1885 the large natural gas fields near Findlay, Ohio, became prominent and the year following large wells were also found in Indiana. These latter developments seemed to give additional assurance of its unlimited supply.

In Pennsylvania, Ohio, and Indiana immense quantities of gas were consumed in the most wasteful manner and in the extravagant display, which in numerous instances turned night into day. The effect upon witnessing mile after square mile illuminated by the burning of escaping wells and torches produced an impression long to be remembered. This extravagance and waste were not realized until many of the then known fields began to show a serious decline in the rock pressure and, knowing the original pressure, it was a simple calculation to show that a large percentage of the quantity of natural gas originally contained in the natural reservoirs had been withdrawn and that something must be done to stop the waste. Even then the reforms were slow and gradual and many companies became bankrupt. It was not until the general introduction of the gas meter in 1890 and 1891 that economy in its use by the consumer was inaugurated. Formerly the natural gas was sold by the size of the orifice through which it was delivered without regard to the manner of its combustion and use. The metre made it to the interest of the consumer to use this convenient fuel in an economical manner. It is estimated that under the metre system a saving of fully one half the gas required to accomplish the same results was made. Another economical improvement introduced consists of shutting in the wells when their flow is not required; their closing or opening being regulated by telephone from a central office. The wells are also more carefully watched and the salt water removed by pumps, instead of by blowing out as formerly. The pipe lines were thoroughly overhauled for leaks and the new pipe afterward used was heavier and of larger diameter, being supplied with heavier thimbles or improved rubber-packed joints. In the cities and towns larger distributing mains are used and a greater number of regulators secured — thereby maintaining a more even pressure — throughout all the changes in consumption, due to changes in temperature.

Production of Natural Gas in the United States.— No other country enjoys the luxury of natural gas to the extent of the people of the United States. It is used in Canada and in a very limited way in England, Germany, Rumania, Galicia, Russia, Persia, India, China, and Japan, but all these countries combined use only 2 per cent of the known world's production of this efficient and convenient fuel, leaving 98 per cent to be consumed by the people of the United States. The total value of the natural gas produced and sold since its introduction, commercially, in the United States, in 1872, up to the close of 1904, was $395,298,090. The following table is compiled from the reports of the United States Geological Survey and shows the value of the production of natural gas in the United States from 1872 to the close of 1904:

Year	Value	Year	Value
1872 to 1884.	$ 9,100,000	1895.........	$ 13,006,650
1885.........	4,857,200	1896.........	13,002,512
1886.........	10,012,000	1897.........	13,826,422
1887.........	15,817,500	1898.........	15,296,813
1888.........	22,629,875	1899.........	20,074,873
1889.........	21,107,099	1900.........	23,698,674
1890.........	18,792,725	1901.........	27,066,077
1891.........	15,500,084	1902.........	30,867,863
1892.........	14,800,714	1903.........	35,815,360
1893.........	14,346,250	1904.........	*41,725,000
1894.........	13,954,400		
		Total......	$395,298,090

*Estimated

Assuming that 8 cents per 1,000 cubic feet was the average price for this period, this value should represent 4,941,226,100,000 cubic feet in amount. If it were possible to confine this immense quantity in a tank whose end was one square mile in area it would require to be 336 miles in length. Its heating value would equal 247,561,000 tons of coal. Large as this quantity seems, it is quite probable that it does not represent one half of the actual quantity taken from the earth's rocky reservoirs since the discovery of petroleum. The early (and in some cases the more recent practice) in developing petroleum fields, was to allow large quantities of natural gas to escape unconsumed. It is often found in the strata above that containing the petroleum and at thousands of oil wells it has been permitted to exhaust itself into the air.

Value of Natural Gas and Petroleum and Their Combined Value, by States, in 1903.— The combined value of natural gas and petroleum produced by 20 States and Territories amounted, in 1903, to $130,509,410, which is greater by $28,462,637 than $102,046,773, the combined value in 1902. Of the combined value for 1903, 27.4 per cent is the proportion furnished by sales of natural gas and 72.6 per cent is the proportion furnished by the sales of petroleum. The value of all the coal produced in the United States in 1903 was $503,724,381. In

1902 the proportion of the value of the natural gas to the petroleum produced was as 30.2 per cent to 69.8 per cent, a comparative decrease in 1903 of 2.8 per cent. These two products are so intimately connected in the strata and methods of development, that their separate and combined value by States for 1903 is appropriate and interesting.

State	Value of Natural Gas	Value of Crude Petroleum	Value of Natural Gas and Crude Petroleum
Pennsylvania	$16,182,834	$18,170,881	$34,353,715
Ohio	4,479,040	26,234,521	30,713,561
West Virginia	6,882,359	20,516,532	27,398,891
Indiana	6,098,364	10,474,127	16,572,491
Texas	21,351	7,517,479	7,538,830
California	104,521	7,399,349	7,503,870
New York	493,686	1,849,135	2,342,821
Kansas	1,123,849	988,220	2,112,069
Kentucky and Tennessee	390,601	486,083	876,684
Colorado	14,140	431,723	445,863
Louisiana	....	416,228	416,228
Indian and Oklahoma Territories	1,000	142,402	143,402
Arkansas and Wyoming	2,460	62,720	65,180
Missouri and Michigan	7,070	4,650	11,720
South Dakota	10,775	....	10,775
Illinois	3,310	....	3,310
Total	$35,815,360	$94,694,050	$130,509,410

The States that produce large quantities of natural gas, as Pennsylvania and West Virginia, distribute it to the adjoining States by a system of pipe lines, so that in some instances the natural gas consumed in a town or city is produced over 200 miles from where it is consumed. Ohio is conspicuous in the table because it consumed much more than it produced, while West Virginia produced much more than it consumed.

Natural Gas Wells and Structural Conditions of Strata.— There is a great variation in the depth of natural gas wells, owing to the diversity of the strata in which the product exists and the changing position of the underlying rocks with reference to the general surface. Some natural vents have produced natural gas in considerable quantities and have proved the incentive for drilling down to the original reservoirs, from which the gaseous fluid was escaping. Other gas wells have been discovered in drilling wells for oil or salt brine. Some of the most important gas fields have been located by expert geologists, who have traced out the summits of the anticlinals, or rock waves, for many miles from surface exposures of the strata.

The depth of wells varies from 250 to 3,000 feet, while their diameter varies from 2 inches up to 8 inches; their output, or open flow, varies from 500 cubic feet per day to 35,000,000 cubic feet per day; their shut in, or rock pressure, varies from 1 to 1,500 pounds to the square inch in extreme cases, while 300 to 400 pounds to the square inch and a volume of 1,000,000 cubic feet per day is considered a very fair well. In many of the deeper wells, two or more reservoirs of natural gas are often found. The cost varies from a few hundred dollars in the shallow shale districts to $10,000 in the deep wells in West Virginia. All large wells are usually tubed and a packer set just above the gas sand; the top of the tubing is held by clamps attached to bolts that are anchored and a heavy gate valve attached, so that the well can be shut in and the gas held in the rock when not in use.

The reservoirs in which natural gas is usually found stored when pierced by the drill, are composed of porous sandstone or limestone. In some cases a limited quantity of the gas has been found in shales, but this gas may be regarded as having gradually accumulated from the underlying rock formation. Almost invariably the large reservoirs have been developed in the strata on or near the crests of the anticlinal or rock waves, while petroleum has been generally collected on the lower horizon; and frequently salt water is found at a still lower level. Sometimes, however, the gas fields are entirely isolated from the petroleum producing areas. There are three leading requisites necessary for the accumulation of natural gas in merchantable quantity. These are as follows:

1. An open or porous strata capable of storing the gas under pressure, generally sandstone or limestone.

2. A slate or shale covering of this porous strata to seal in the upper surface and the fractures of the strata saturated with natural gas.

3. A sufficient flexure or relief of the strata to enable the separation of the salt water and the petroleum from the natural gas, which is almost invariably found in the higher portion of the strata.

These gas reservoirs have been accumulating for ages the gas they contain, gradually reaching the maximum pressure.

Original Pressure.— The original pressure of natural gas reservoirs has been found in many cases equal to the hydrostatic balance, or, in other words, to the weight of a column of water equal to the vertical distance between the reservoir and the surface of the ground. Allowing 2.3 feet for each pound, or about 43 pounds to the hundred feet, a reservoir at a depth of 1,000 feet should show 430 pounds rock pressure per square inch. This hydrostatic pressure has been equalized to a certain extent by a large number of minute vents that have permitted the escape of the lighter hydrocarbons to the surface. These vents are of common occurrence throughout the Appalachian gas field from northwestern central New York to central Tennessee and along the great Cincinnati uplift from central Kentucky to northern Ontario.

These vents have during past ages allowed

the gas to escape in immense quantities, amounting to unnumbered millions of cubic feet, so that the supplies from which we are now drawing are presumably but a small fraction of what has been produced in the earth.

Record of Natural Gas Wells.— There were 15,689 wells producing gas at the beginning of 1904. The total number of wells drilled for natural gas in 1904 was 3,095 and of this number 566 were unproductive, amounting to 18.3 per cent.

In the following table will be found the number of wells producing natural gas at the close of 1903, together with the number of unproductive or dry holes completed in the latter year, by States. The number of feet and miles of pipe lines from 2 inches up to 36 inches diameter in use at the close of 1903 is also given by States, as reported by the United States Geological Survey.

out increasing the size of the main lines, many of the large companies have erected powerful compressing plants in convenient localities. Many of these plants are models of mechanical engineering skill. The compressors are, in many cases, operated by large internal combustion engines of from 500 to 1,500 horse-power each. About 9 cubic feet only of natural gas is required to develop one horse-power and 1,000 cubic feet of natural gas at a pressure of 0 compressed to 270 pounds, by consuming 33⅓ cubic feet, or 3⅓ per cent, where very close to double this quantity is required if the natural gas be consumed under boilers and the steam used in condensing engines. There are very few known fields outside of Kansas, Indian and Oklahoma Territories, that have not been more or less depleted. The deep sand reservoirs in southwestern and central Pennsylvania and those of West Virginia should keep up a fair

State	Wells		Total Pipe Laid to Dec. 31, 1903	
	Producing, Dec. 31, 1903	Non-producing Holes Drilled in 1903	Feet	Miles
Pennsylvania	5,915	126	53,886,301	10,205.74
Ohio	1,523	62	27,876,583	5,279.66
Indiana	5,514	242	34,838,053	6,598.01
West Virginia	1,099	43	18,224,176	3,451.55
New York	707	11	7,413,194	1,404.01
Kansas	666	66	-,598,720	1,060.34
Kentucky	123	3	747,385	141.55
Tennessee	2	....	900	.17
California	38	....	347,668	65.85
Colorado	3	....	75,760	14.35
Texas	18	3	149,336	28.28
South Dakota	5	....	26,950	5.10
Missouri	22	4	38,015	7.20
Illinois	43	5	45,618	8.64
Arkansas	2	....	60,000	11.36
Wyoming	2	....	500	.01
Indian and Oklahoma Territories	7	1	4,700	.89
Total	15,689	566	149,333,859	28,282.71

Exhaustion of Natural Gas Reservoirs.— Many of the original natural gas fields have been practically exhausted and a large number of the producing companies have had to seek new localities, where a fresh supply could be secured. This has been often accomplished by drilling deeper wells in more remote regions. The original gas fields adjacent to Pittsburg have been practically exhausted; most of the supply now comes from the deep natural gas sands of southwestern Pennsylvania and West Virginia, distant from 80 to 100 miles. The gas pressure in the original pool in northwestern Ohio is practically exhausted. That of central Indiana has only about 15 per cent of the original pressure and volume remaining. The newly developed field in eastern central Ohio has recently supplied a large and increasing quantity to the inhabitants of that State. West Virginia has, for the past ten and more, especially in the last four years, supplied a yearly increasing quantity of natural gas to Ohio and Pennsylvania. New York and Ohio have also been supplied by Pennsylvania. In all the natural gas fields it requires a constant drilling of new wells and connecting them to the main lines to keep up the supply, which is constantly being depleted. Owing to the decrease in pressure at the wells and the desire to deliver large quantities of natural gas to distant consumers, without increasing the size of the main lines, many

supply for many years to come. As there are no virgin fields now known to exist it will be impossible to continue the present enormous supply for a long period of years in the future. What may result from the deeper drilling of wells in localities where structural conditions are favorable, is a problem for future determination.

Occurrence, Geological Horizons, etc.— In the United States the principal sources of natural gas are located on the west slope of the great Appalachian uplift, extending from New York through Pennsylvania and West Virginia to southern central Kentucky, with a considerable portion of southeastern Ohio, also along the northern portion of the great Cincinnati uplift in northwestern Ohio and central Indiana and southeastern Kansas. There has been recently developed an important natural gas field in eastern central Ohio. These areas, briefly described, produced in 1903 99.5 per cent of the value of the entire output of the United States.

In California, Texas, Louisiana, Colorado, South Dakota, and Alaska gas is found in geologically more recent rocks, but no attempt is here made to correlate the rocks of one field with those of another. In the Mississippi valley to the eastward natural gas occurs almost universally in rocks of Palæozoic age, extending

from the highest Carboniferous down at least as far as the Trenton limestone, a distance of over 9,000 feet. The rocks vary greatly in thickness from place to place, so that no one section can be regarded as typical of all parts of the region. The 50 gas-bearing horizons known are composed of very different material, ranging from the coarser sandstones of the Upper Carboniferous and Catskill period to the finer sands of the Middle and Lower Devonian, the limy sands of the Silurian period, the crystalline limestones of the Ordovician, and the crystalline sands of the Cambrian period.

Uses.—Natural gas is used principally as a source of heat and light in the domestic service. It is employed extensively in industrial establishments for many purposes, notably in the generation of steam, in the manufacture of glass, puddling of iron, in roasting ores, in heating furnaces, in the manufacture of steel and pottery; it is also utilized as a source of power in the gas engine, used in drilling and operating oil and gas wells, and in pumping oil, and as a general source of power for all purposes. The heat value stored in natural gas is greater than that caused by any artificial combination of carbon and hydrogen, and is a perfect fuel as it issues from its original rock-sealed reservoirs. No preparation is necessary for its combustion and no residue is left. It is not affected by ordinary temperature and it is easily distributed by pipes to points of consumption. It is a most economical source of light and power, and an ideal household fuel. Lampblack is the only commercial article that is made directly from natural gas.

Illuminating Properties.—The illuminating properties of natural gas vary in different localities, because of the difference in the percentage of the heavier hydrocarbon, ethane (C_2H_6). All the natural gas found adjacent to petroleum fields has a larger proportion of ethane than the gas farther removed, and therefore the candlepower is considerably greater. Ordinary natural gas, if consumed with a common tip at the rate of 7 or 8 cubic feet per hour, will yield about 6 or 7 candlepower. In an ordinary Argand burner with chimney, it will give about 12 candlepower in consuming 5 to 6 cubic feet per hour. When natural gas is consumed in contact with a mantle of alkaline earth (thoria, etc.), the result is the cheapest and best illuminant known. When the price of natural gas is 25 cents per 1,000 cubic feet, and 50 candlepower is obtained from a consumption of 2½ cubic feet per hour, the cost per candlepower per hour is only 0.00125 of a cent.

Domestic Consumption.—There were 630,000 domestic consumers of natural gas during 1903; and it is estimated that in the western portions of New York and Pennsylvania, in central and western West Virginia, and in Ohio, Indiana, and Kansas, not less than 4,500,000 persons received the benefit of natural gas used as a fuel and an illuminant. Over 8,000 manufacturing establishments were also supplied.

The introduction of natural gas into the household, for which it is eminently fitted, has been accomplished without personal inconvenience or loss of life, except in very rare cases. The risk from fire is less than when wood and coal are used. There have been some cases of asphyxiation when a stove has been burned in a room without a flue connection, as it has been found by experiment that combustion under these conditions is imperfect, especially so as the air in the room becomes more and more saturated with carbonic acid and the vapors of water, the result being the formation of poisonous carbonic oxide.

Calorific Value.—The calorific or heat value of natural gas varies slightly in different localities, as the amounts of carbon and hydrogen vary. Those natural gases which contain the highest percentage of carbon give the best results in evaporating water. The standard used in measuring the evaporation of water is called the British thermal unit, written B. T. U., and is the amount of heat necessary to raise 1 pound of pure water 1° F. at or near 39° F., which is the temperature of the maximum density of water. The quantity of air necessary for the perfect combustion of natural gas varies from 10.4 to 10.8 parts of air to 1 part of natural gas. A number of tests have fully demonstrated that when ordinary care is taken in burning natural gas under boilers in actual service, 1 cubic foot of natural gas will do the work equivalent to the evaporation of 1 pound of water from and at 212° F. Since 20 cubic feet of ordinary natural gas weigh 1 pound, 1 pound of natural gas will evaporate 20 pounds of water, while, under similar conditions, 1 pound of petroleum will evaporate only 16 pounds of water, and 1 pound of good coal will evaporate but 10 pounds of water; therefore 10 cubic feet of natural gas or one half a pound is equal to one pound of good coal. In fact in a number of tests with a Klein or a Kirkwood burner, .87 cubic foot of natural gas has evaporated 1 pound of water from and at 212° F., which will make 17,400 cubic feet equal to one ton of good coal. The actual heating effect of natural gas as a fuel approaches much nearer the theoretical result than when coal is used. The price paid by the domestic consumer for natural gas varies in localities, ranging from 13 to 27 cents per 1,000 cubic feet. The consumers near the supply pay less than those farther off. Manufacturers pay less, ranging from 6 to 18 cents per 1,000 cubic feet. About 20,000 cubic feet of natural gas will equal one ton of good bituminous or anthracite coal. If we assume the average price to be 22 cents per 1,000, then $4.40 worth of gas will produce the same heating effect of one ton of good coal delivered in the bins — to which must be added the expense of shoveling it into the furnace and the removal of the ashes, as well as the inconvenience of the necessary dust and dirt which invariably accompanies a coal fire.

The Natural Gas Engine.—Natural gas, as applied to the internal combustion engine, has caused a complete revolution in the methods of securing power throughout the gas belt. It has in nearly all instances superseded any other source of power in pumping petroleum wells. In some instances this has been done by substituting a gas cylinder for the steam cylinder, using the same engine bed. The economy in the use of natural gas and the dispensing with the costly and troublesome boiler, with its constant attendant, has brought it into great favor for all sources of power, from a 1 horse-power up to 1,500 horse-power engine.

The following table gives the equivalents of

natural gas and coal for both the gas and steam engine per indicated horse-power per hour:

Type of Engine	Equivalent of gas and coal — Gas (*Cubic feet*)	Coal (*Pounds*)
Large natural-gas engine, highest type....	9	0.9
Ordinary natural-gas engine............	13	1.3
Triple expansion condensing steam engine.	16	1.6
Double expansion condensing steam engine.	20	2.0
Single cylinder and cut-off steam engine...	40	4.0
Ordinary high pressure, without cut-off, steam engine	80	8.0
Ordinary oil well pumping steam engine...	130	13.0

Products of Combustion.— The products of combustion are water and carbonic acid, slightly over two cubic feet of the former in the form of water vapor and about one foot of carbonic acid gas for each cubic foot of natural gas consumed; both are invisible and nearly odorless. Somewhat more than 2 cubic feet of oxygen are necessary, but, owing to the air being composed of a larger percentage of nitrogen, a little over 10 cubic feet of air is required for thorough combustion.

It has been found that in a stove without a flue connection the combustion is imperfect, especially so if the air in the room becomes more or less saturated with carbonic acid and the vapor of water from lack of fresh air. Under these conditions there is a small percentage of carbonic monoxide (CO) produced, which is a deadly and insidious poison, and if breathed by a man or an animal will soon cause death, even when a comparatively small percentage is present.

When but a small stovepipe connecting with a flue is used, recent tests have demonstrated that no carbon monoxide (CO) is formed in the room thus provided, the greater portion of the products of combustion being carried outside as the fresh air is drawn in to supply their place. On the other hand, where there is no flue or other large opening a number of fatal results and narrow escapes from asphyxiation have occurred.

Carbon monoxide (CO) does not usually exist to such an extent in the natural gas produced in West Virginia or Pennsylvania as is found elsewhere. On the other hand, analysis shows its presence in the natural gas produced in the Lima-Indiana field to the average extent of about one half of 1 per cent, and to the average extent of 1 per cent in the natural gas produced in Kansas. Formaldehyde is in some cases formed upon putting the cold surface of a teapot in contact with the gas jet of a stove, or when the gas flame impinges on the cold sheets of a steam boiler. Its presence in small quantities is made known by its pungent and irritating effect upon the nostrils and throat. The effect is dangerous, yet there are no cases known in which death has resulted from this gas thus generated.

Composition.—Analysis of natural gases and manufactured gases, their weight and heating quality per 1,000 cubic feet; also their specific gravity compared:

Constituents	Average for Penna. and W. Virginia	Average for Ohio and Indiana	Average for Kansas	Average of Coal Gas	Average of Water Gas	Average of Producer Gas from Bit. Coal
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Marsh gas (CH_4).....	80.85	93.60	93.65	40.00	2.00	2.05
Other hydrocarbons...	14.00	.30	.25	4.00	.00	.04
Nitrogen	4.60	3.60	4.80	2.05	2.00	56.26
Carbonic acid, CO_2...	.05	.20	.30	.45	4.00	2.60
Carbonic oxide, CO...	.40	.50	1.00	6.00	45.50	27.00
Hydrogen	.10	1.50	.00	46.00	45.00	12.00
Hydrogen sulphide....	.00	.15	.00	.00	.00	.00
Oxygen	Trace	.15	.00	1.50	1.50	.05
Total	100.00	100.00	100.00	100.00	100.00	100.00
Pounds in (a) 1,000 cubic ft............	47.50	48.50	49.10	33.10	45.67	75.00
Specific gravity, air being one............	0.624	0.637	0.645	0.435	0.600	0.985
B. T. U. per 1000 (b) cubic feet..........	1,145,000	1,095,000	1,100,000	755,000	350,000	155,000

(a) 1,000 cubic feet of dry air at an atmospheric pressure of 14.7 pounds and at a temperature of 60° F. weighs 76.12 pounds and is a mechanical mixture of 23 parts of oxygen and 77 parts of nitrogen by weight.

(b) B. T. U.= British Thermal Units, which indicate the heat necessary to raise 1 pound of pure water at 39° F. one degree.

F. H. Oliphant,
Of U. S. Geological Survey, Oil City, Pa.

Gas Poisoning, poisoning by the vapor of some substance taken into the body through the air-passages. Theoretically, a large number of substances used in the arts may cause gas poisoning; practically, there are only a few that need special attention.

In general, gaseous substances reach a certain grade of concentration before they become poisonous. This varies with each gas. Forms

of gas poisoning comparatively common are numerous, particularly in Europe, where many dangerous industries are established that are here unknown. A partial list of these includes poisoning from muriatic acid gas (HCl), occurring in factories in which soda, glass, and colored wools are made or handled; from saltpetre gas (NO_3H, NO_2H), which is found in fireworks factories, and from sulphurous acid gas (SO_2), which causes trouble in wool-dyeing factories, in paper manufactories, in making sulphuric acid, in sugar-making and in disinfection. Ammonia gas (NH_3) also frequently causes poisoning; and chlorine (Cl), bromine ($Br.$), iodine (I), in gaseous form, may all cause fatal poisoning. Formaldehyde gas (CH_2O), which is being widely employed as a disinfectant, is a violent poison. Sulphuretted hydrogen (H_2S) is a severe poison, 6 per cent in the air constituting a menace to health. Practically all of these gases possess distinctive odors sufficient to give warning of their presence. Conditions in many of the industries are such, however, that they are endured at the risk of life. Even the mining of gold may be considered a hazardous trade, by reason of cyanide poisoning. It is, however, a matter of immense moment to realize that there are gaseous poisons that are destitute of any odor whatever, and hence are especially to be guarded against. The most important of these are carbon dioxide (CO_2) and carbon monoxide (CO), both of which are odorless gases in the degree of concentration sufficient to cause serious poisoning. Carbon-dioxide poisoning occurs in crowded halls, in theatres, in closed cars, in tunnels, etc., when the normal proportion of this gas is disturbed by oxygen consumption and carbon-dioxide production, the resulting poisoning being from a combination due to these two factors. Carbon-dioxide poisoning is the cause of death in drowning and hanging. (See CARBON DIOXIDE.)

Poisoning from carbon monoxide (CO) is not frequent in this country, except by the medium of illuminating gas, of which it is an important constituent, but where old-fashioned stoves without vents are used, and where there is insufficient air to convert the CO to CO_2, this form of poisoning is not uncommon. Thus the French novelist Zola is supposed to have been a victim of it.

Poisoning by illuminating gas is extremely common, occurring both by intent and accidentally. The character of the poisoning and its mode of treatment will vary with the composition of the particular variety of illuminating gas that may be inhaled. The so-called «water-gas» is particularly rich in CO. The leading symptoms of this form of poisoning are, in the beginning, headache, with sense of pressure in the temples, ringing in the ears, flashes before the eyes, beating of the temporal arteries, dizziness, and perhaps unconsciousness. At times the patient feels as though under the influence of liquor. If the breathing of the gas continues, dangerous symptoms develop. There is marked redness of the skin, with unconsciousness; the blood is bright-red — a marked contrast to the dark blood with blueness of the skin seen in carbon-dioxide poisoning. Occasionally there are cramp-like convulsions. The pulse is at first full and strong; later it is thin and small. The breathing is slowed, and becomes a kind of snoring. Vomiting is common, and occasionally the vomit is drawn into the lungs and causes the additional symptoms of suffocation. The patient may die in deep slumber. If the patient recovers, the headache and dizziness may persist for days or weeks, and changes in the pulse may be noted, with signs of sugar and albumen in the urine. From the poisoning there may occur a number of after effects. Blisters on the skin, shingles (q.v.) along the nerve-trunks, bleeding from the nose, the lungs, the liver, the kidneys, and paralysis of the extremities, may each or all develop. The diagnosis is not simple, but the chief signs are the reddish face, the snoring breathing, the absence of alcoholic breath, and perhaps the slight odor of gas in the room. The treatment should be energetic. The patient should be brought into fresh air at once, the clothing loosened, and hot bottles applied to the extremities. If the air-passages are blocked by vomited matter these should be cleared. Active rubbing of the skin with coarse towels, mustard-water applications to the extremities, and artificial respiration should be instituted. The breathing of camphor vapor, or well-diluted ammonia gas may stimulate the breathing. So long as the heart beats there are hopes of reviving the patient. The injection into the rectum of large quantities (2 quarts) of hot salt solution (110°–118° F.), a teaspoonful of salt to a pint of water, is of great service. Small quantities of whiskey (½ ounce) may be added to this. The transfusion of salt solution into the veins is sometimes necessary, but this is an operation to be performed only by the medical practitioner.

Gas Tar. See COAL TAR.

Gascoigne, găs-koin′, **William**, English astronomer: b. England about 1612; killed at Marston Moor 2 July 1644. He invented the micrometer which, as constructed by him, consisted principally of two parallel wires or metallic plates, capable of being moved, which were placed in the focus of the eye-glass of the telescope. The image was comprehended between these, and by means of a scale for the measure of angles its diameter was determined. Gascoigne used his instrument in various astronomical observations, and in determining the magnitude or distance of terrestrial objects.

Gasconade (găs-kō-nād′) **River**, southeast Missouri, an affluent of the Missouri River, fed by two head-streams rising in Webster and Wright counties. After a winding northeastward course of about 200 miles it flows into the Missouri River, 35 miles below Jefferson City. Its course is through an undulating and picturesque country, and it is navigable for nearly half its length to Arlington.

Gases, General Properties of. The word «gas» was coined by the Belgian chemist Van Helmont, in the first half of the 17th century. It was possibly suggested to him by the Dutch word «geest,» signifying a ghost or spirit, the allusion being to the apparently imponderable nature of gaseous bodies. It is known, however, that all gases possess both weight and inertia, and that they differ from other kinds of matter, in these respects, solely by reason of their lesser densities. Any object that is submersed in a gas is buoyed up by an amount equal to the weight of the gas that it displaces,

in accordance with the same principle that holds true of solids that are submersed in liquids; and in making refined determinations of the weight of an object proper allowance must be made for the difference in the buoyant effect of the air upon the object weighed, and upon the weights against which it is balanced. It will be seen that it follows, by reason of the principle of buoyancy, that no gas has any apparent weight, when it is weighed in an atmosphere identical with itself in density. If a sphere or other vessel of convenient form is weighed, both when filled with a given gas and when completely exhausted by means of an efficient air-pump, the difference in the two observations gives the weight of the gas, because the buoyant effect of the air upon the containing vessel is the same, whether it is full or empty. In this way the weights of many of the better known gases have been determined with considerable precision. Following are the densities of some of the more familiar gases, as expressed in grams per cubic centimetre at the freezing point of water, and under a barometric pressure of 76 centimetres of mercury at Paris:

Gas	Density
Dry air	0.001293
Oxygen	0.001430
Nitrogen	0.001256
Hydrogen	0.0000896
Carbon dioxid	0.001978
Carbon monoxid	0.001234
Chlorine	0.003133
Ammonia gas (NH_3)	0.000770

The fact that gases have weight and inertia, and that they are also compressible, renders the mathematical study of their internal motions especially difficult. Aerostatics and aerodynamics, which treat, respectively, of the conditions of mechanical stability of gaseous masses, and of the motions of which such masses are capable, are therefore more intricate and difficult than hydrostatics and hydrodynamics, which treat, respectively, of the equilibrium and of the motions of incompressible fluids.

A gas which is mechanically at rest exerts, against the vessel that contains it, a pressure that is everywhere perpendicular to the surface upon which it acts, and which has everywhere the same intensity, save for the slight variation due to the action of gravity,— a variation which is so slight that it can be neglected in all but the most refined physical investigations. When the gas is in motion, the case is different, and the pressure phenomena are complicated, hard to compute, and quite difficult to measure with any considerable approach to precision. In general, the internal pressure of a gas is least in those regions in which the gas is moving fastest. In a mixture of gases, each constituent contributes to the total pressure by an amount equal to the pressure that it would exert if it occupied the given space alone. Like the other gaseous laws, this one (which is known as "Dalton's law") is a close approximation to the actual fact when the density of the gas to which it is applied is not too great. At high pressures, or exceedingly low temperatures, it gives results that are measurably different from the actual facts of observation.

When a gas is subjected to a continuously increasing pressure, its behavior depends upon its temperature. If the temperature is greater than a certain critical value peculiar to each gas, it will never liquefy, no matter how great the pressure to which it is subjected; but if the temperature is lower than this critical value, the gas will ultimately condense into a liquid. (See CRITICAL POINT; GASES, LIQUEFACTION OF.) There is no essential distinction between a gas and a vapor, a "vapor" being merely a gas that is in such a condition that it may be condensed into the liquid form by a comparatively small change of temperature or pressure. The so-called "permanent gases," such as hydrogen and nitrogen, were formerly thought to be incapable of liquefaction; but it is now known that all gases can be liquefied, provided their temperatures are sufficiently reduced, and the phrase "permanent gas" is rarely used at the present day.

When the pressure of a given mass of gas is varied while the temperature remains constant, it is found that the volume is very nearly inversely proportional to the pressure. Thus if a mass of air is enclosed in a cylinder that is provided with a tightly-fitting piston, and the pressure upon it is increased so as to be five times as great as at first, the volume of the air becomes reduced to one fifth of the initial value, provided the compression is performed so slowly that the heat that is set free by it can escape by conduction and radiation. This principle, which was first discovered by the English physicist Robert Boyle, is known as "Boyle's law" in England and the United States. In continental Europe, however, it is known by the name of Mariotte, a French physicist, who discovered it independently of Boyle, but subsequently to him.

When a gas is heated under a constant pressure, its volume increases in a marked manner. All substances exhibit a change of volume under these circumstances, but in gases the change is far greater than for any other bodies, with the exception of certain liquids that are very near to their critical points. The increase in volume of a gas per degree of rise of temperature, when expressed as a fraction of the volume that the gas occupies when it is exposed (at the same constant pressure) to a temperature of 32° F., is called its "coefficient of expansion." The coefficients of expansion of the more familiar gases, such as oxygen, hydrogen, nitrogen, and carbon dioxid, are all very nearly equal; and they have, moreover, substantially the same value, whatever the constant pressure may be at which the experiment is performed. These two facts were discovered independently by Dalton, and by Gay-Lussac, and the first of the two was also discovered, previously, by the French physicist Charles, by whose name it is commonly known. Neither of these is exact, for delicate measurements have shown that the coefficient of expansion of a gas at constant pressure depends to a slight extent both upon the nature of the gas, and upon the intensity of the constant pressure at which the experiment is made. The coefficient of expansion (at constant pressure) of air, oxygen, hydrogen, nitrogen, and carbon monoxid may be taken as 0.00204 on the Fahrenheit scale, or 0.00367 on the Centigrade scale, for ordinary purposes, when the constant pressure at which the expansion takes place is not far from the ordinary atmospheric pressure. The corresponding coefficient for carbon dioxid is slightly larger than this, and may be taken as 0.00206 for the Fahrenheit scale, and 0.00371 for the Centigrade,

The increase in the pressure of a gas, when the gas is heated while its volume is kept rigorously constant, and the increase expressed as a fraction of the pressure that the same gas has when it is exposed (at the same constant volume) to a temperature of 32° F., is known as the gas's «coefficient of expansion at constant volume,» although, as a matter of fact, there is really no «expansion» at all in such a case. The coefficients of expansion of gases are very nearly identical, whether the expansion takes place at constant pressure, or at constant volume. For more precise data with respect to the expansion-coefficients of gases, see THERMOMETER; THERMOMETRY.

When a gas is allowed to expand so as to do work (by pushing a piston before it, or in any other way), the temperature of the gas falls, unless it is maintained by the addition of heat from without; the fall of temperature being due to the fact that a portion of the energy that the gas contains is used up in performing the external work. See ENERGY.

When there is absolutely no addition of energy from without, and the gas performs all the work that it is capable of performing in expanding from one of the two given pressures down to the other one, the expansion is said to be «adiabatic.» If, on the other hand, a mass of gas that is confined at a definite pressure and temperature is allowed to expand into a vacuum, it does no external work, since the vacuum opposes no resistance to it. In this case the gas is said to undergo «free expansion.» The earlier experiments of Joule upon the free expansion of air indicated that it is not attended by any change of temperature whatever. Subsequent more refined experiments executed by Joule and Kelvin, and by Natanson, upon various gases, show that in all cases free expansion is attended by a slight change of temperature. Our experimental knowledge of these slight changes is still exceedingly imperfect, which is greatly to be regretted, since a thorough understanding of the phenomena of free expansion is essential to the numerical evaluation of the absolute thermodynamical scale of temperature. See TEMPERATURE; THERMODYNAMICS.

If P_0 represents the ordinary atmospheric pressure, and V is the volume, at T° and under a pressure of P atmospheres, of a definite mass of gas whose volume is known to be V_0 at the pressure P_0 and at the freezing point of water (T being the temperature as reckoned from this freezing point), then by combining the laws of Boyle, and of Charles and Gay-Lussac, we may easily show that the pressure, temperature and volume of a gas must fulfil the simple relation $PV = P_0V_0(1 + kT)$, where k is the coefficient of expansion of the gas. Since the laws which are thus combined into one expression are only approximately true, the mathematical expression just given is also only approximate. It is very convenient for purposes of calculation, however, when it is not essential that the results which are sought should be known with the utmost accuracy. A mathematical relation of this sort, expressing the relation that must subsist between the pressure, volume and temperature of a gas, is called the «elastic equation,» or the «characteristic equation,» of the gas.

A rigorously exact equation of this sort undoubtedly exists for every gas; but its precise form is not known in any case. The equation here given is a good first approximation to it, when the gas is sufficiently removed from its critical state; but in the immediate vicinity of the critical state the foregoing equation fails utterly. A better form of characteristic equation was proposed by the Dutch physicist, Van der Waals, as follows: $P = \frac{R(1+kT)}{V-a} - \frac{b}{V^2}$ where P, V, T and k have the same significance as before, and the remaining letters represent constants peculiar to the gas considered. Van der Waals' form of the characteristic equation includes the preceding simpler one as a special case, and it represents the general nature of the phenomena in the vicinity of the critical point quite faithfully.

It has already been said that no actual gas conforms rigorously to the laws of Boyle and Charles and Gay-Lussac, and also that the change of temperature is never rigorously zero, when a gas undergoes free expansion. It is often convenient, however, especially in illustrating the principles that underlie the action of heat engines, to conceive of an ideal gas which would fulfil all these conditions absolutely. An imaginary gas of this kind is commonly called a «perfect gas.» This name is unfortunate in some respects, however. A departure from the approximate laws mentioned does not imply any actual imperfection in the gas, and it would be better to follow the lead of those writers who call the imaginary gas an «ideal gas.»

Although the coefficient of expansion of a gas is very nearly the same, whether the pressure is kept constant, or the volume, the case is very different with respect to the specific heat; for the specific heat of any gas (that is, the quantity of heat required to raise the temperature of a unit mass of the gas by one degree), is always greater when the pressure of the gas is constant, than when its volume is constant. The heat absorbed by a gas when its temperature rises is expended partly in increasing the internal energy of the gas, and partly in performing the external work that the gas does when it expands. When the volume of the gas is kept constant, no external work is done by the gas; and hence the heat absorbed is less in this case than it is when the gas is allowed to expand while being heated, so as to keep its pressure constant. The quantity of heat required to raise the temperature of a pound of water by one degree being taken as the unit, the quantity required to raise the temperature of a pound of gas by the same amount, while its pressure is kept constant, is given, for several of the more familiar gases, in the accompanying table:

GAS	Specific Heat (Constant Pressure)
Air	0.238
Oxygen	0.217
Nitrogen	0.244
Hydrogen	3.409
Chlorine	0.121
Carbon monoxid	0.244
Carbon dioxid	0.20

The specific heat of carbon dioxid has been given to only two places of decimals, because it varies considerably with the temperature.

The specific heat of a gas at constant volume is hard to measure, and hence it is usually inferred from the observed specific heat at constant pressure, together with the ratio of the two specific heats, as obtained by experiments of a different kind. In the mathematical theory of sound, for example, it is shown that the velocity with which sound will travel through a gas depends upon the ratio of the two specific heats of the gas. It is therefore possible to determine, by calculation, the ratio in question, when the actual speed of sound through a given gas has been found by experiment. The values obtained for the several gases in this way, by different observers, are not as accordant as might be desired. The ratio of the specific heat at constant pressure to that at constant volume appears to have approximately the following values: Oxygen, 1.40; hydrogen, 1.41; nitrogen, 1.41; carbon monoxid, 1.42; carbon dioxid, 1.26.

One of the best-known phenomena of gases is diffusion. Thus when two bottles containing different gases are brought together, mouth to mouth, with the lighter gas in the upper bottle, it is found that the two become perfectly mixed after a time, the lighter gas traveling downward, and the heavier one upward. This phenomenon is believed to be due to the fact that gases consist of a multitude of little particles, or molecules, which are flying about among one another with considerable speed. Many of the molecules in each bottle will in time wander into the other one, so that a sensibly homogeneous mixture eventually results.

Liquids absorb gases, or dissolve them, and sometimes in considerable amounts. Carbon dioxid, for example, is quite soluble in cold water, especially under pressure; and it is upon this fact that the possibility of preparing effervescent mineral waters and wines depends. Porous solids, like freshly prepared charcoal, will also absorb gases in considerable quantity, the gases being retained, apparently, in the form of very thin films, covering the walls of pores of the absorbent substance. (See ABSORPTION.)

When two gases combine with each other chemically, simple volumetric laws are observed, which indicate («Avogadro's law») that the number of molecules per unit of volume is the same in any two gases that have the same temperature and pressure. Two volumes of hydrogen, for example, combine with one volume of oxygen, to produce water; one volume of hydrogen combines with one volume of chlorine, to produce hydrochloric acid gas; one volume of nitrogen combines with three volumes of hydrogen, to produce ammonia gas; and so on.

(See GASES, KINETIC THEORY OF; HEAT; THERMODYNAMICS.) Consult, also: Kimball, 'Physical Properties of Gases'; 'The Laws of Gases' (miscellaneous memoirs, edited by Carl Barus); 'The Expansion of Gases by Heat' (miscellaneous memoirs, edited by W. W. Randall); Preston, 'The Theory of Heat.'

Gases, Kinetic Theory of, the theory which regards gases as aggregates of discrete particles (or «molecules») of matter that are incessantly flying about and colliding with one another, the space in which they are moving being presumably absolutely vacuous, save for the omnipresent luminiferous ether. (See ETHER.) According to this theory, the molecules which are in the outer parts of a given mass of gas must beat incessantly upon the walls of the containing vessel, flying back again from these walls in the same way that they fly away from one another after collisions among themselves. This being the case, it is plain that the walls of the containing vessel are in the same condition as a target against which a furious storm of bullets is striking perpetually. Such a storm of bullets would tend to force the target in the direction in which the bullets were moving before collision; and if the impacts were frequent enough, they would have an effect upon the target which could not be distinguished from a continuous pressure. And if we pass, in thought, from target to retaining vessel, and from bullets to molecules, we shall have a good conception of the kinetic theory of gaseous pressure. Before the behavior of molecular aggregates can be studied by mathematical methods, it is necessary to make certain assumptions with regard to the nature of the molecules. Some of the received assumptions have been made on account of their apparent necessity, and others have been made for no reason whatever, except that they simplify the mathematical treatment of the problems that arise. Thus molecules are assumed to be perfectly elastic, because it has been held to be evident that if they were not so, their incessant collisions must result in a gradual loss of velocity, which would not cease until they were all at rest. The assumption of perfect elasticity is therefore commonly regarded as a logical necessity, since we do not observe any tendency toward rest among the molecules of gases; that is, we do not perceive any tendency toward a fall of pressure, in a gas that is isolated, thermally and otherwise, from its environment. In the earlier mathematical investigations of the properties of gases, from the standpoint of the kinetic theory, the molecules were assumed, furthermore, to be exceedingly small (practically mere physical points), and they were considered to be hard, smooth, and spherical, and to exert no influence upon one another when not in actual contact; these assumptions being made, not because it was considered to be in the least degree likely that molecules have such properties, but merely in order to lessen the mathematical difficulties involved in the subsequent analysis,— difficulties that are serious enough, even when the problem is made as simple as possible. For example, they were assumed to be hard, in order that collisions might be considered as having no sensible duration. They were assumed to be exceedingly small, in proportion to the space in which they move, in order that the probability of a collision in which three or more molecules should come together at once might become vanishingly small in comparison with the probability of a collision in which the molecules come together in pairs, the discussion of the more complex collisions being thereby avoided. They were assumed to be spherical, because spheres can collide with each other in only one way; whereas other bodies (cubes, for example) can come together in the greatest variety of ways, according to their relative orientation at the moment of collision. They were assumed to be smooth, in order to avoid the necessity of taking account of the rotations that are produced when rough spheres

glance against one another obliquely. The assumptions stated above were adopted in what may be called the Maxwellian period of the development of the kinetic theory, and Maxwell and other mathematicians made elaborate investigations of the behavior of a practically infinite number of molecules having these properties, when once set in motion in a finite space.

Following are a few of the results obtained by the mathematical study of such molecules as are defined above. It is evident, in the first place, that the velocities of the various molecules are not all equal; for even if such equality existed at any given instant, it would be quickly destroyed by the inter-molecular collisions. Maxwell investigated the distribution of velocities that must subsist in a gas composed of such molecules, and gave a formula by which it is possible to calculate, at any given instant, the number of molecules that have velocities equal to, or less than, any assigned velocity. Thus if the total number of molecules present be taken as unity, the number having a velocity less than the average velocity is 0.533; the number having a velocity less than one half the average velocity is 0.112; the number having a velocity less than twice the average velocity is 0.9829; and the number having a velocity greater than four times the average velocity is 0.0000000074. It appears, therefore, that although any velocity whatever is theoretically possible (so far as Maxwell's formula is concerned), the incessant collisions bring about a sort of averaging which is effective enough to ensure that an almost vanishingly small proportion of the whole number will be actually moving with a speed as great as four times the average. The number having higher velocities falls off with still more remarkable rapidity; for example, the formula shows that less than one molecule in 10^{63} will be moving with a speed as great as 10 times the average. When two or more different kinds of molecules are simultaneously present, the molecules in each set being exactly alike and very numerous, and every molecule being hard, smooth, small, spherical, and perfectly elastic, Maxwell found that the different sets will mix with one another uniformly, and that the velocities in each set will be distributed precisely as though the other sets were not present. The average velocity in each set will be different, however, from the average velocity in every other set, the set in which the molecules are heaviest having the smallest average velocity. In fact, the velocities, in such a case, will be such that the average kinetic energy of a molecule of one set will be precisely equal to the average kinetic energy of a molecule of any other set.

Some of the mathematical difficulties that appeared almost insuperable to Maxwell have been partially overcome by other mathematicians, and, largely owing to the labors of Boltzmann, we now have a far more general form of the kinetic theory of gases. Before stating the nature of the generalizations that Boltzmann effected, it is necessary to offer a short explanation of the expression "degrees of freedom." A mathematical point is completely defined when its three co-ordinates are given; it can move by the variation of any one of these three co-ordinates, while the other two remain constant. Such a point is therefore said to possess three "degrees of freedom." A rigid body in space similarly has six degrees of freedom. Three co-ordinates must be given in order to fix the position of some one of its points,— say its centre of gravity; and it may also have three independent rotations about three independent axes passing through the point so fixed. If the rigid body is not free to rotate, or if (as in the case of the smooth spherical molecules imagined by Maxwell) there is no force acting which tends to produce rotation, the number of degrees of freedom may be considered as reduced to three, the three co-ordinates of the centre of gravity being then sufficient to define the state of the body completely. In particular, a molecule shaped like a dumb-bell may be considered to have but five degrees of freedom, if it is so smooth that collisions cannot set it in rotation about its axis of symmetry. The number of degrees of freedom of a rigid body is six, in the most general case; but if two or more rigid bodies be joined together by hinges, or any other analogous mode of connection that will allow of relative motion between the components, the number of degrees of freedom of the system so formed becomes greater than six. Thus a sytem composed of N straight rods, connected together by flexible joints at their ends, has $(2N+3)$ degrees of freedom.

Boltzmann's form of the kinetic theory may now be stated as follows: Let there be a gas composed of any number of sets of molecules, such that the molecules belonging to each set are exactly like one another, though a molecule belonging to one set may be totally unlike a molecule belonging to another set. Let these molecules have any number of degrees of freedom (which number of degrees may be different in the different sets), and let them be acted upon by parallel forces (such as gravity), or by forces tending toward fixed centres, or by internal forces (that is, forces acting within the individual molecules, between their parts). Let all the bodies be very small in comparison with the total space they occupy, so that the chance of their colliding three or more at a time is practically nothing. Moreover, let them be very numerous, and let them be perfectly elastic, and let them be smooth, so that when they collide the only force tending to make them rotate is that due to normal impact. Let them be set in motion among one another with any distribution of velocities; and let them be hard, but not infinitely so, the force called into play during collision being very great, but not necessarily infinite (as it would be if the hardness were infinite); and let the duration of a collision be exceedingly short, yet not necessarily zero. Then Boltzmann reaches the following conclusions: (1) After a short time, the law of distribution of positions and velocities in each set of the molecules will be precisely the same as it would be if all the other sets were absent; so that each set behaves as a vacuum to all the rest, so far as the distribution of velocities, and the density of aggregation of the molecules in any given region, are concerned. (2) The law of distribution of the velocities in each set is the same as that deduced by Maxwell for spherical molecules. (3) The average kinetic energy *of translation* of the molecules of any one set is equal to the average kinetic energy *of translation* of any other set. (4) The

total kinetic energy of each set of molecules (including that due to translation, rotation, etc.,) is divided up equally among the different degrees of freedom of that set. This last proposition is undoubtedly one of the most remarkable ever enunciated with regard to molecules, and it appears not to have met with unqualified acceptance among mathematicians, though there are many experimental facts which tend to show that it is at all events a good approximation to the truth.

Although Maxwell and Boltzmann agree that the percentage of molecules that have velocities much larger than the average velocity is very small, it must be remembered that according to either form of the kinetic theory there is always a certain number of molecules that have velocities of any assigned magnitude whatever; and Stoney has pointed out that if this conclusion is really sound, one consequence of it is, that the earth must be continually losing molecules of its atmosphere by their flight from the upper layers of the atmosphere, into space. A molecule of air escaping into space with a vertical velocity greater than about seven miles per second would possess sufficient momentum to carry it beyond the range of the earth's attraction forever. The loss of air that takes place in this manner is probably very gradual, but it is doubtless real, and in the course of ages it may result in the entire dissipation of the earth's atmosphere into the depths of space. It has been suggested that the absence of an atmosphere about the moon, and the apparent rarity of the atmosphere of Mars, may be due to this cause; the action having been more rapid in the cases of these two bodies, because their attractive power is smaller, and hence a larger proportion of atmospheric molecules would have the critical speed necessary to enable them to pass off into space.

It has been stated, above, that Boltzmann found that in a gaseous mixture each set of molecules would assume the same distribution that it would have if it existed in the given space alone. This corresponds to the known experimental fact that gases of different kinds will diffuse into one another, so as to eventually form a homogeneous mixture. When a bottle of some strong-smelling gas, like ammonia, is opened in a room containing still air, we cannot perceive the odor at any considerable distance until quite a time has elapsed. The molecules of the ammonia vapor are indeed moving with high velocities, but they continually strike against air molecules, rebounding from them in such a manner that in any given region there are almost as many of them returning toward the bottle as there are going away from it. They are forced to describe zigzag lines which are so very crooked that by the time an ammonia molecule has reached a point actually 10 feet distant from the bottle, it has in all probability traveled many miles. But eventually the ammonia molecules and the air molecules become thoroughly mixed, just as the kinetic theory predicts. Boltzmann's theory also teaches that in a gaseous mixture the distribution of velocities is the same in each set of molecules as it would be if that set existed in the same space alone. If the explanation of gaseous pressure suggested at the beginning of this article is correct, it follows that each constituent of the gaseous mixture will contribute to the total pressure that the gas exerts against the vessel containing it, by an amount equal to the pressure that this constituent would exert if it existed in the same space by itself. This corresponds to the known law of Dalton with regard to gaseous mixtures,— the law which states that in a gaseous mixture the total pressure is equal to the sum of the partial pressures due to the several constituents separately.

It may be shown that the average kinetic energy of translation of the molecules of a given mass of gas is sensibly proportional to the absolute temperature of the gas. This being admitted, it is easy to understand the reason for Boyle's law. (See GASES, GENERAL PROPERTIES OF.) For so long as the temperature of the gas remains constant, the average velocity of translation of the molecules also remains constant, and therefore the average effect of the blow that a molecule strikes against the walls of the containing vessel is also constant. But the pressure, in this case, will vary in direct proportion to the number of blows that the molecules strike against a unit area of the walls in a given time, and this will also vary in direct proportion to the number of molecules that a cubic inch of the gas contains. We see, therefore, that if the temperature of a gas remains constant, the pressure that the gas exerts will vary directly with the density of the gas; or, to state the same fact in another way, the pressure will be inversely proportional to the volume of the gas, which is Boyle's law.

Avogadro's law may be derived in a somewhat similar manner. Thus let P be the pressure that a gas exerts against a unit area of the containing vessel, let N be the number of molecules that it contains, per unit of volume, and let K be the average kinetic energy of translation of its molecules. Then the kinetic theory shows that the pressure of the gas can be expressed in the following manner: $P = \frac{2}{3} NK$. If two different kinds of gas are to be compared, we may conveniently distinguish the values of P, N and K that relate to the separate gases by using the subscripts 1 and 2. Then for one gas we shall have $P_1 = \frac{2}{3} N_1K_1$, and for the other $P_2 = \frac{2}{3} N_2K_2$. If the pressure is the same in both gases, we have $P_1 = P_2$, and it is easily seen that this involves the equation $N_1K_1 = N_2K_2$. Now, if the temperatures of the two gases are also equal, the average kinetic energy of translation is likewise the same in both gases; that is, $K_1 = K_2$. Taking this into account, we see that it follows that $N_1 = N_2$; or, in other words, when two gases have the same temperature and the same pressure, they also contain the same number of molecules per unit of volume; and this is Avogadro's law.

Knowing the mass of a given volume of a gas, and the pressure that the gas exerts against the boundaries that confine it, we may calculate the average speed that the constituent molecules of the gas must have, in order to produce the observed pressure. The formula by which the calculation is effected need not be given here, but some of the results are of interest. Thus it is found that at 32° F. the molecules of the more familiar gases have the following average velocities, in feet per second: Hydrogen, 5,571; oxygen, 1,394; nitrogen, 1,488; carbon dioxid,

1,491; carbon monoxid, 1,189. At higher temperatures, the velocities are greater, being proportional, for any one gas, to the square root of the absolute temperature.

A very important application of the kinetic theory of gases, which has recently been especially emphasized in connection with the determination of the atomic weight of argon (q.v.), relates to the ratio of the specific heats of a gas. Boltzmann's theory shows that if the specific heat of a gas at constant pressure be divided by its specific heat at constant volume, then the quotient can be expressed in the form $1 + \frac{2}{n}$, provided the effects of such forces as may exist between the different molecules of the gas are negligible, n being the number of degrees of freedom of the molecules of gas under consideration. This equation, it will be seen, affords a means of ascertaining the number of degrees of freedom of the molecule of a gas, by setting the foregoing expression equal to the observed value of the ratio of the specific heats, and then solving the equation for n. By this method, it has been inferred that the molecules of hydrogen, nitrogen, oxygen, and carbon monoxid have each five degree of freedom; for the ratio of the specific heats of these gases approximates closely to 1.4, which is the value of the foregoing expression for $n = 5$. If the molecules of a gas were really smooth spheres,— so smooth that they could not be set in rotation by their collisions,— then we should have $n = 3$, and hence the ratio of the specific heats would be 1.667, a value which is actually observed in the cases of argon, helium, mercury vapor, cadmium vapor, and perhaps a few other substances. Hence it is inferred that argon and helium really are elementary bodies; because it is difficult to conceive of a compound body behaving, so far as collisions are concerned, as though its molecules were smooth spheres; and if they had any other shape, it would be necessary to admit that they have at least five degrees of freedom (since it is impossible for any body in free space to have four degrees of freedom), and this would reduce the calculated value of the ratio of the specific heats to 1.400, a value which it is apparently impossible to reconcile with the results of direct observation.

Most of the results of the kinetic theory, as given above, involve the assumption that the effects of the mutual attractions that may exist between the individual molecules of a gas are small, on the whole. The forces, when they exist, may be great; but we assume that under ordinary circumstances the radius of sensible action of these forces is small in comparison with the length of the average distance that the molecules travel, between successive collisions. When, by reason of the gas being greatly compressed, this assumption becomes of doubtful validity, the foregoing conclusions become correspondingly weakened. The average distance that a molecule travels, between successive collisions, is known as its "free path"; and numerical estimates of the length of the free path have been obtained, by methods which cannot be given in the present article. Thus the free paths of some of the more familiar gases are as follows (expressed in ten millionths of an inch), the gases being supposed to be at 32° F., and under ordinary atmospheric pressure: Oxygen, 38; nitrogen, 36; hydrogen, 67; carbon monoxid, 36; carbon dioxid, 25. When the density of a gas is diminished, the average free path of the molecules increases in direct proportion to the decrease in density. Thus in the high vacua that prevail in Crooke's tubes, the mean free path may be measured in inches; the free path for hydrogen, for example, being about 6.7 inches, when the density of the gas has been reduced to the millionth of the normal density at 32° F. and atmospheric pressure.

The whole kinetic theory of gases is likely to be profoundly modified in the near future, when physicists have learned more about the "electron" (q.v.), which is now commonly regarded as the foundation unit in molecular architecture. For further details concerning the subjects touched in this article, consult Meyer, 'Kinetic Theory of Gases'; Risteen, 'Molecules and the Molecular Theory of Matter.' See also CRITICAL POINT; GASES, GENERAL PROPERTIES OF; MATTER, PROPERTIES OF; MOLECULAR THEORY; THERMODYNAMICS. A. D. RISTEEN.

Gases, Liquefaction of. It has been known for ages that matter is capable of existing in three different physical states,— the solid state, the liquid state, and the gaseous state. It has also been long known that most solids can be transformed into liquids by the application of heat, and that many liquids (water, for example,) can also be transformed into vapor by a further addition of heat. Conversely, it was known that certain aëriform substances, such as steam, can be converted into liquids by the mere abstraction of heat. It was believed, however, that an essential difference exists between gases and vapors, vapors being condensible to the liquid form, while gases were believed to be permanently aëriform, and not condensible by any experimental means at our disposal. In the early part of the 19th century the validity of this distinction came to be doubted, and Faraday, at the suggestion of Davy, undertook the systematic study of the question. He succeeded in reducing to the liquid form quite a number of gases that had previously resisted liquefaction. His general method consisted in generating the gas in large quantities in a limited space, so as to produce a very high pressure, under the influence of which (when the experiment was successful) the gas passed into the liquid state. The most convenient way of carrying out this experiment is to make use of an inverted U-shaped glass tube, one of whose legs contains a chemical preparation suitable for the generation of the gas in question, while the other end dips into a freezing mixture; the tube being hermetically sealed. If cyanide of mercury be heated in one of the legs of a tube of this kind, for example, cyanogen gas is generated in such quantities that the pressure causes a large part of it to condense in the chilled end of the tube. Chlorine was liquefied by Faraday in this manner in 1823. Shortly afterward Thilorier succeeded in solidifying carbon dioxid by the combined application of intense cold and great pressure, and Cagniard de la Tour, Regnault, Natterer, and many other experimenters, improved the methods in use with the result that many of the gases that had been previously regarded as non-condensible were reduced to

the liquid form. Oxygen, hydrogen, nitrogen, and some few other gases still resisted all attempts at liquefaction, however, and these were still called "permanent gases," although the conviction had forced itself upon physicists that all gases could be conquered, if the necessary conditions of success could be discovered. The subject was in this state when Andrews undertook his classical study of the phenomena of liquefaction of carbon dioxid. In 1863 he made the following announcement: "On partially liquefying carbonic acid by pressure alone, and gradually raising at the same time the temperature to 88° F (31° C.), the surface of demarcation between the liquid and gas became fainter, lost its curvature, and at last disappeared. The space was then occupied by a homogeneous fluid, which exhibited, when the pressure was suddenly diminished or the temperature slightly lowered, a peculiar appearance of moving or flickering striæ throughout its entire mass. At temperatures above 88° F. no apparent liquefaction of carbonic acid, or separation into two distinct forms of matter, could be effected, even when a pressure of 300 or 400 atmospheres was applied." It appeared, therefore, that a certain temperature exists, above which carbon dioxid cannot be liquefied by any pressure whatever; and this discovery was soon verified in the case of other gases. The temperature in question is known as the "critical temperature" of the gas under experiment. (For its numerical values in the cases of the more important gases, see Critical Point.) The reason that oxygen, nitrogen and hydrogen resisted previous attempts at liquefaction, even when the pressure was pushed to 3,000 atmospheres, was that the critical points of these gases are very low indeed,— far below any temperature at which the attempt at liquefaction had been made. The problem of liquefying the so-called "permanent gases" was, therefore, resolved into the production of exceedingly low temperatures. One means for the production of such temperatures was given by Thilorier, who showed that by mixing solid carbon dioxid with ordinary ether, a temperature as low as 165° F. below zero may be attained. The cold produced by the expansion of the gases themselves has also been utilized for the production of the necessary degree of cold, and in the best modern forms of apparatus the gas, after being cooled by its own expansion, is furthermore caused to circulate about the pipes that are conducting fresh supplies of gas to the point at which the expansion takes place. In all cases, every care is taken to make use of any process or device which will lower the temperature of the gas; and by the strictest attention to this general principle, it has been found possible to liquefy every known gas except helium and possibly one or two of the other rare gaseous elements recently discovered in the atmosphere. It is highly probable that these will also succumb, when they can be obtained in sufficient quantity to be treated by the same methods that have yielded success in the case of so obdurate a gas as hydrogen. Hydrogen was first liquefied, in quantity, by Dewar, in 1898. Consult: Hardin, 'Rise and Development of the Liquefaction of Gases.'

Gas'kell, Elizabeth Cleghorn Stevenson, English novelist: b. Chelsea 29 Sept. 1810; d. Alton, Hampshire, 12 Nov. 1865. She was brought up by an aunt at Knutsford in Cheshire, where she spent the greater part of her early life. This town is said to be the original of the village in her story of 'Cranford,' described as inhabited exclusively by maiden ladies and widows of limited means. She married in 1832 the Rev. William Gaskell (q.v.), a Unitarian clergyman then recently appointed minister of Cross Street Chapel, Manchester. Her first work, 'Mary Barton,' appeared in 1848. The 'Athenæum' says it raised the Lancashire dialect almost to the level of the broad Doric used by Scott in his northern novels. In this, as in most of her works, Mrs. Gaskell appears as a social reformer. Her moral and economical theories may be questioned, but as a writer of fiction she wields artistic and dramatic powers of a high order. 'Mary Barton' represents the struggles formerly so rife in Lancashire, and which have since passed in new phases and into other quarters, between workmen and employers. 'The Moorland Cottage' appeared in 1850; and in 1853, her next novel, 'Ruth,' which aims a distinct blow at the common moral judgments of society. The tale is powerfully told, but will hardly satisfy a dispassionate reader of the soundness of Mrs. Gaskell's moral theories. Her later works include: 'Cranford' (1853), an English classic, the popularity of which is constantly increasing; 'North and South' (1855); 'Sylvia's Lovers' (1860); 'Cousin Phillis' (1865); 'Wives and Daughters' (1866). In 1857 appeared a 'Life of Charlotte Bronte,' of which the 'Athenæum' observed "As a work of art we do not recollect a life of a woman by a woman so well executed."

Gaskell, William, English Unitarian clergyman: b. Latchford, near Warrington, Lancaster, 24 July 1805; d. Manchester 11 June 1884. He was graduated from the University of Glasgow in 1824; studied theology at Manchester College, York, in 1825–8; was junior minister of Cross Street Chapel, Manchester, from 1828, and senior minister from 1854. In 1840–6 he was secretary to Manchester New College, and in 1846–53 professor there of English history and literature. He also taught logic and English literature in Owens College. He was an editor of the 'Unitarian Herald' 1861–75; made a favorite rendering of Luther's 'Ein feste Burg'; wrote many original hymns, of which some appear in James Martineau's 'Hymns of Praise and Prayer' (1874); and published numerous tracts and sermons, besides 'Two Lectures on the Lancashire Dialect' (1844), appended to the 5th edition (1854) of the 'Mary Barton' of his wife, Elizabeth Cleghorn Gaskell (q.v.).

Gasoline. A colorless, inflammable fluid, the first and highest distillant of crude petroleum; an arbitrary name first given to certain gravities of naphtha used for making illuminating gas in house-plants. Specifically all gasoline is naphtha in the manufacturing laboratory. The specific gravity ranges from .58 to .90, compared with the unit 1 assumed for water, at 60° F. For every 20° F. the specific varies .01. Measured on the Baumé scale, higher specific gravities are denoted by lower numbers, and lower specific gravities by higher numbers without definite graduations. For example, a change of 6° on the Baumé scale, from 74° to 68°, means

a difference in specific gravity of .017, the increase being from .690 to .707; in the other direction a change from 74° to 80° Baumé shows a difference of .022, or a change in specific gravity from .690 to .668. Gravities from .50 to .65 are used in varnishes, paints, oilcloth manufacture, etc., as driers; gravities .65 to .68 are generally known as "stove" gasoline; .68 to .76 are used in burners for steam automobiles and in carburetters of gasoline (hydrocarbon) automobiles; higher gravities are used in cleansing establishments, and to raise the specific gravities of lower grades which contain more or less grease from lower distillation. Crude petroleum yields about 15 per cent gasoline (naphtha) for all gravities and about 4 per cent only for gravities above .76. Gasoline, like all other products of crude petroleum, was for a long time disposed of as waste in the effort to make kerosene; it was there and had to come out. In the latter sixties it was exported to Europe in small quantities. Representing the lightest portion of crude oil, gasoline is extracted by distillation, just as whiskey is produced, and in much the same sort of apparatus. The stills or retorts may be of any shape and size; both are immaterial, and practice has differed. They may be cylinders placed horizontally and in banks, or cylindrical or conical, standing perpendicular and having curved domes. Rectification is effected by a copper coil, many feet in length inside the retort and passing through the crude petroleum, carrying steam at a high pressure, assisted by a gentle direct fire varying from 122° to 257° F. Each retort has an inlet pipe for the crude petroleum and an outlet pipe for the distillant. The outlet pipe passes over the side and down to a cooling coil or worm immersed in cold running water. This worm acts as a condenser that changes back to liquid form the vapors driven off the petroleum by the heat. A smaller pipe leads from the condenser to a receiver having glass sides through which the "still-man" can watch the flow of distilled oil. From the bottom of the receiver a number of pipes lead to different storage tanks, each pipe having a cut-off valve to regulate the flow of the varying gravities to their proper tanks, each cut-off being known as a "sweeping." The first product from the retort is a gas formed by the mingling of the fumes of the petroleum with the small volume of air left in the reservoir; this is sometimes conveyed to the fire-box and used as fuel. When the first flow of the distillant reaches the receiver, the still-man tests it with a Baumé hydrometer for its specific gravity. Usually this first flow is found to be about .90 specific gravity. It is of a highly volatile nature, so nearly a gas that when exposed to air it rises in an invisible vapor and will quickly evaporate. It cannot be confined for any length of time in barrels, even if they have been successively coated inside with wax and repeatedly painted outside to make them air-tight. Even in the coldest weather it will pass through the wood. For these reasons this gravity is not put out commercially, but is used to bring up the gravity of a mass made up of lower gravities; that is to say, if .88 is being tanked the still-man lets all the .90, .89, .88 and enough of the .87 gravity oil flow into the receiver to make an average mixture of the density wanted. The oil is repeatedly tested with the hydrometer until the right gravity has been produced in the receiver, when it is let off to the proper storage tank. If .82 is the next grade wanted, all the gravities from .86 down to perhaps .78 are commingled in the receiver until a uniform fluid of the required gravity is obtained to let off into its tank. This process is called "fractioning," and is continued through gasoline into kerosene, the next distillant, down about .42 specific gravity. Gasoline is known in England as "petrol," in France as "essence." The English term is a copyrighted name first given some years ago by a refining firm called upon for high gravity naphtha by an experimenter in hydrocarbon mixtures. See PETROLEUM.

ERNEST L. FERGUSON,
Writer on Gasoline Engines and Components.

Gasom'eter, or **Gas Holder,** an inverted cylindrical vessel of sheet iron, placed in a tank of cast iron, stone, or brick containing water. A pipe ascends from the bottom of the tank through the water, to admit the gas to the space between the surface of the water and the crown of the gas holder. Sometimes a second pipe descends through the water and the bottom of the tank, for the issue of the gas to the main pipe. Frequently only one pipe is used for the inlet and outlet alternately. The water is for the purpose of retaining the gas within the vessel. The pressure of the gas raises the gas holder; and the weight of the gas holder, or such part of it as is not taken off by balance weights, impels the gas through the pipes. When balance weights are necessary, they are attached to the edge of the crown of the gas holder by long chains, which pass over pulleys on the top of columns which serve also to guide the motion of the vessel in rising and falling. Gas holders are constructed of various sizes, some exceeding 200 feet in diameter and having nearly 6,000,000 cubic feet capacity.

Gasometric Analysis. In chemistry, the art of separating, and of estimating, quantitatively, the several constituents of a gaseous mixture. The methods employed may be divided into three general classes: (1) Those based on diffusion; (2) those based upon the absorption of certain constituents by substances over or through which the mixed gases are passed; and (3) those in which the given mixture is oxidized, and its original composition inferred from an examination of the products of the oxidation. In the application of diffusion methods, the mixture is caused to pass through a porous septum of graphite, gypsum, or baked clay. The lighter constituents pass through faster than the heavier ones, so that a partial separation is effected. By causing the mixture to pass through a succession of such porous partitions, the concentration effects may be correspondingly increased. This method has been employed in many chemical researches, especially for effecting the concentration of gaseous substances that are present in a mixture in very small quantity. Its value as an experimental method was well demonstrated in connection with the study of the rare gases of the atmosphere, in effecting the separation of helium from argon. In general, the rates of diffusion of two gases are proportional to the square roots of their densities; and the density of argon being 10 times that of

helium, it follows that helium will diffuse through a porous septum about 3.2 times as fast as argon.

In the analysis of gases by the absorption of certain of their constituents by means of chemical substances, use is made of the following facts (among others): Water absorbs HCl, HBr, and HI, very readily; solid caustic potash, when moist, absorbs all acid gases, such as CO_2, SO_2, H_2S, HCl, etc.; dilute sulphuric acid absorbs all alkaline gases, such as ammonia; concentrated sulphuric acid also absorbs water, alcohol, ether, methyl oxid, and (more slowly) propylene and its homologues; alkaline solutions of pyrogallic acid absorb oxygen very readily; cuprous chlorid in solution in hydrochloric acid absorbs oxygen and carbon monoxid; and solutions of CrO_3 and of $KMnO_4$ absorb H_2S and SO_2. In the study of special problems, certain unusual absorbents also suggest themselves. Thus in the isolation of the rare gases of the atmosphere, great use was made of the fact that red-hot metallic magnesium absorbs nitrogen gas, while it is without effect upon argon, helium, and the other gases of that group.

The combustion methods are particularly applicable to those cases in which the mixture to be analyzed is capable of being burned so that the final products are water, carbon dioxid, and free nitrogen, together with excess of such gas as may have been added in order to effect the combustion. The combustion is effected in an instrument called a "eudiometer," which commonly consists of a graduated glass tube that is closed at the upper end, and which is provided with a pair of platinum electrodes fused through the glass near the closed end. A sample of the gas to be analyzed is introduced into the tube (the lower end of which dips into a mercury bath), and its volume is determined by reference to the graduation marks; readings being simultaneously taken of the thermometer and barometer, so that the observed volume of the gas can be reduced, in the subsequent calculations, to standard conditions of temperature and pressure. A known quantity of such gas as may be required to effect the combustion is next added; pure oxygen being used if the gas under examination is rich in carbon and hydrogen, and pure hydrogen being used if it is highly oxygenated or chlorinated. It is usual, also, to add a known quantity of "fulminating gas," which is prepared by the electrolysis of water, and consists of pure oxygen and hydrogen, in the proportion in which they combine to form water. The mixture is then exploded by passing an electric spark between the electrodes that are sealed into the eudiometer near its closed end, and after the heat developed by the explosive combustion has been lost by radiation, the volume of the mixture is again determined. The several constituents that remain in the eudiometer tube are then removed, one by one, by the temporary introduction, into the tube, of suitable absorbent substances. The volume of the gaseous contents of the eudiometer tube are observed after each partial absorption, and from the data so obtained the quantities of carbon, oxygen, hydrogen and nitrogen that were present in the original sample may be calculated. Consult: Hempel, 'Methods of Gas Analysis'; Sutton, 'A Systematic Handbook of Volumetric Analysis.' See also, in this encyclopedia, CHEMICAL ANALYSIS; SPECTROSCOPE.

Gasparin, Agénor Etienne, ä-zhā-nôr ā-tē-ĕn gäs-pä-răn, COMTE DE, French author: b. Orange, France, 12 July 1810; d. near Geneva, Switzerland, 4 May 1871. Elected to the Chamber in 1846, he attracted attention by his advocacy of religious liberty, prison reform, abolition of slavery, and social purity. At the outbreak of the American Civil War he published two books maintaining the justice of the Federal cause entitled, 'The Uprising of a Great People' (1861), and 'America Before Europe' (1862). Other important works were: 'Slavery' (1838); 'Christianity and Paganism' (1850); 'Liberal Christianity' (1869); 'Innocent III.,' published posthumously.

Gasparin, Valérie Boissier, vä-lā-rē bwä-sē-ā, COMTESSE DE, French author: wife of A. E. de Gasparin (q.v.): b. Geneva, Switzerland, 13 Sept. 1813; d. near Geneva 1894. Two of her works obtained the Montyon prize at the Academie Française: 'Marriage from the Christian Point of View,' and 'There are Poor in Paris and Elsewhere.' Among her other publications are: 'Journey in the South by an Ignoramus'; 'Let's Go Make a Fortune in Paris'; 'A Book for Wives'; 'Read and Judge' (strictures on the Salvation Army), and 'The Near and the Heavenly Horizons.' Several of her books were translated into English, the last named being read very widely in America in its English form.

Gaspé, gäs-pā, **Philip Aubert de,** Canadian author: b. Quebec 30 Oct. 1786; d. there 29 Jan. 1871. A lawyer, afterward sheriff, he became involved in debt for which he was imprisoned four years; and when released, secluded himself on his estate of St. Jean Port-Joli. His 'Old-Time Canadians' (1862), and his 'Memoirs' (1866), treat of Canadian traditions and folklore, and were written in French. The former was perhaps the most popular book ever published in Canada. An English translation was made by Mrs. Pennie.

Gaspé, Canada, a district in the province of Quebec, forming the northern part of the peninsula that lies between the Bay of Chaleur and the Gulf of St. Lawrence. Area, 7,500 square miles. Pop. (1901) 52,200. The name is sometimes extended to the whole peninsula. Cape Gaspé is a bold headland of the Schikshock or Notre Dame mountains, terminating the peninsula and forming the north shore of Gaspé Bay. The inhabitants are chiefly engaged in important fisheries, which with the export of lumber, form the staple industries. Gaspé, a village and port of entry in Gaspé Bay where Cartier landed in 1534, is the capital and commercial centre of the district. Pop. (1901) 454.

Gaspee, The, British revenue vessel, burned 1772. She was an armed schooner of eight guns, stationed at the entrance of Narragansett Bay to prevent that evasion of the British navigation laws which had largely built up the prosperity of the Atlantic coast and was almost the entire subsistence of Rhode Island. Its authorities connived at the traffic, and at a regular price furnished false flags, which for years passed muster, but Lieut. Dudingston of the Gaspee adopted the method of searching thoroughly every trading vessel which entered or left the bay, without regard to her flag or papers, and sending the contraband goods to

Boston for adjudication. This meant ruin to Rhode Island; the executive wrote demanding Dudingston's authority, and the chief justice sent a sheriff on board; both held that his proceedings were illegal, as he should have a commission from the governor and be sworn in. They were referred to the admiral, and then to the British secretary of state. On 9 June 1772, the regular packet left Newport for Providence without notifying Dudingston, who gave chase but ran the Gaspee aground at Namquit Point, seven miles below Providence, at low tide. That night the leading men of that city, with a company of assistants, set out in eight large boats, boarded and captured the vessel, badly wounding the commander, set the crew on shore, and burnt the schooner. The Rhode Island authorities opened an investigation with great zeal, and offered rewards for the apprehension of the guilty parties, but could discover none. The home government was greatly incensed, and appointed colonial commissioners, who sat at Newport 4–22 Jan. 1773, to make inquiry, and ordered Gov. Wanton to arrest the offenders and send them to England for trial. The governor and the chief justice applied to the assembly for instructions, which body referred it to the discretion of the chief justice, who refused to allow any arrests for transportation to be made.

Gasquet, găs'kĕt, **Francis Aidan**, English Roman Catholic ecclesiastic: b. London 5 Oct. 1846. He was educated at Downside College, Bath, and was superior of the Benedictine Monastery, and college of Saint Gregory, Downside 1878–84. He is the presiding abbot of the English Benedictines and has published: 'Henry VIII. and the English Monasteries' (1888–9); 'Edward VI. and the Book of Common Prayer' (1890); 'The Great Pestilence' (1893); 'The Last Abbot of Glastonbury' (1895); 'A Sketch of Monastic Constitutional History' (1896); 'The Old English Bible, and Other Essays' (1897); 'The Eve of the Reformation' (1900).

Gassendi (properly **Gassend**), **Pierre**, pē-ār gä-sāṅ-dē, French philosopher and mathematician: b. Champtercier, near Digne, Provence, 22 Jan. 1592; d. Paris 24 Oct. 1655. At 19 he was appointed to fill the chair of philosophy at Aix, and although the authority of Aristotle was still warmly maintained, he ventured publicly to expose the defects of his system. His lectures on this subject, 'Exercitationes Paradoxicæ adversus Aristotelem' (1624), gave great offense to the votaries of the Aristotelian philosophy, but obtained him no small reputation with others, through whose interest, after taking orders, he was made doctor of divinity. A second book of 'Exercitationes' excited so much enmity that he ceased all direct attacks on Aristotle, although he still maintained his preference for the doctrines of Epicurus, which he defended with great learning and ability. He strenuously maintained the atomic theory, in opposition to the views of the Cartesians, and, in particular, asserted the doctrine of a vacuum. On the subject of morals he explained the doctrines of Epicurus in a sense the most favorable to morality. He was appointed lecturer on mathematics in the Collége-Royal at Paris in 1645. He is ranked by Barrow among the most eminent mathematicians of the age, and mentioned with Galileo, Gilbert, and Descartes. Gassendi was the first person who observed the transit of Mercury over the sun. His chief works are: 'De Vita Moribus et Doctrina Epicuri' (1647); 'Institutio Astronomica,' 'Syntagma Philosophiæ Epicuri' (1649); 'Tychonis Brahæi Copernici, Peurbachii et Regiomontani Vitæ' (1654).

Gasterop'oda, the largest and most typical and familiar of the four classes of mollusks (phylum *Mollusca*). The name refers to the most prominent tribal characteristics, namely, that the inferior surface of the body forms a flattened sole or disk, by the contractions of which the animal advances. In all these animals the primitive symmetry of the body is obscured by the unequal development of parts, whence results the spiral disposition of the majority. The simplest gasteropods, however, such as the chiton, are symmetrical, not lop-sided like the higher forms. They have the mouth at one end of the long axis of the body, the anus at the other; the gills, kidneys, genital ducts, and circulatory organs are paired; there are two pairs (pedal and visceral) of nerve cords running parallel to one another along the body, and the ganglia are slightly developed. Of all mollusks these simplest gasteropods are probably nearest the hypothetical worm-like ancestor. When a shell is present it consists of only one piece, whence the name «univalve,» formerly applied to the class; or if of more than one piece the separate portions are placed one behind the other in the axis of the body (*Amphineura*, chitons). The gasteropods agree with the cephalopods in possessing a distinct head, containing a feeding instrument or «tongue» in the form of a lingual ribbon, but are separated from that class by the mode of formation of the shell, and by the absence of arms around the head. The lingual strap or odontophore consists of a central portion (*rachis*) and lateral pieces (*pleuræ*). On all three of these, on the central, or only on the lateral regions, are placed silicious denticles, whose number, form, and arrangement have been made the basis of classification of genera.

Mode of Life.— Though the number of terrestrial gasteropods, breathing the air directly by means of a pulmonary chamber, is very large — over 6,000 living species — those living in water are greatly in the majority, including over 10,000 forms, mostly marine. Of these, some 9,000 or so belong to the prosobranchs or *Streptoneura*, a relatively small minority being opisthobranchs and nudibranchs. The heteropods and some opisthobranchs enjoy a free-swimming pelagic life, but most marine forms frequent the coasts either on the shores or along the bottom. Deep-sea gasteropods are comparatively few. The locomotion effected by the contractions of the muscular «foot» is in almost all cases very leisurely, and the average tendency is toward sluggishness. As to diet, the greatest variety obtains; most prosobranchs with a respiratory siphon and a corresponding notch in the shell are carnivorous, and so are the active heteropods; most of the rest are vegetarian in diet. Numerous genera, both marine and terrestrial, are very indiscriminate in their feeding; others, are as markedly specialists, keeping almost exclusively to some one vegetable or animal diet. Some marine snails partial to echinoderms have got over the digestive difficulty presented by the calcareous character of the skins of their vic-

tims by a secretion of free sulphuric acid from the mouth. This acid changes the carbonate of lime into sulphate, which is brittle and readily pulverized by the rasping tongue. A few are parasitic — for example, eulima, stylifer, and the very degenerate *Entoconcha mirabilis*, all occurring in or on holothurians.

Life-history.— The eggs of gasteropods are usually small, and are surrounded with albumen, the surface of which becomes firm, while in the common snail (*Helix*) and some others there is an egg-shell of lime. The eggs not unfrequently develop into embryos within the parent, but in most cases they are laid, either singly or in masses, and often with cocoons. Few objects are more familiar on the seashore than the clustered egg-cases of the whelk, which together form a ball often about the size of an orange. Inside each of the numerous egg-cases are many embryos, but only a few reach maturity, the others serving as food material, an infantile cannibalism or struggle for existence not uncommon in the class. As to development it may be noted that the ovum divides more or less unequally, according to the amount of yolk, that a gastrula-stage occurs as usual, and that this is succeeded in typical cases, first by a «trochophore» and afterward by a «veliger» larva (see MOLLUSCA).

General Interest.— As voracious animals, furnished with powerful rasping organs, many gasteropods play an important part in the struggle for existence among marine organisms, while other terrestrial forms are most destructive devastators of vegetable and flowering plants. The manner in which numerous plants are saved from the ravages of snails, by their chemical and physical characters, is an interesting subject of investigation recently worked out by Prof. E. Stahl. From very early times, various gasteropods, such as whelks, have been utilized for human consumption and also as bait, while yet more frequently the shells, often so beautiful in form and color, have been used for the decoration of the person and the dwelling, for the basis of cameos, as domestic utensils, or even as weapons, and in many other ways. From the mucous glands of the roof of the gill-cavity in the genera *Purpura* and *Murex*, there exudes the famous secretion, at first colorless, but afterward becoming purple or violet, which furnished the ancient Tyrian dye.

Geological History.— A few gasteropods occur in strata as far back as the Cambrian, from which remote period they have continued with a steady increase. Almost all the Palæozoic genera are now extinct, and during these ages the siphon-possessing forms seem to have been almost, if not altogether, unrepresented. A host of new gasteropods appeared in the Jurassic period, and many of the modern families have their origin in Cretaceous times. Numerous as the fossil forms are, the number of types wholly extinct is comparatively small; both as regards persistence of types and increase of numbers, the gasteropods are a peculiarly successful class.

Classification.— The grouping of forms within the class is as follows, according to the latest conclusions of naturalists, as summarized by Cooke in the third volume of the Cambridge Natural History' (1894):

Class GASTEROPODA; order *Amphineura;* sub-orders, *Polyplacophora, Aplacophora;* order, *Prosobranchiata;* sub-orders, *Diotocardia, Monotocardia;* order, *Opisthobranchiata;* sub-orders, *Tectibranchiata, Ascoglossa, Nudibranchiata, Pteropoda;* order, *Pulmonata;* sub-orders, *Basommatophora, Stylommatophora.*

(For the characters of the orders see *Classification* in the article ANATOMY.) The sub-divisions are based upon different anatomical categories in each order. Thus the first sub-order of *Amphineura* embraces all the ordinary chitons having a foot and plated shell, both of which are absent in the degraded *Aplacophora*. Among the *Prosobranchiata* (which embrace the ordinary marine shells) two auricles in the heart characterize the *Diotocardia*, a single auricle the *Monotocardia*, of which the strange pelagic *Heteropoda* are now regarded as only a subordinate group. The *Opisthobranchs* are classified according to gill-features; and the *Pulmonata*, according to relative position of the eyes.

See MOLLUSCA, and consult the works cited thereunder, especially Cooke, 'Shells' (New York 1896), in which will be found many instructive references to other authorities.

Gaston, William, American jurist: b. Newbern, N. C., 19 Sept. 1778; d. Raleigh, N. C., 23 Jan. 1844. He was graduated at Princeton 1796; was admitted to the bar 1798; elected to the State Senate 1799; and congressman 1813–17, voting with the Federalists and opposing the «Loan Bill.» Returning to the practice of the law he obtained great reputation as an orator, and was frequently a member of the State legislature. He drew up the act creating the supreme court of North Carolina and served as judge of that court 1834–44. During his later years he was a Whig, opposing nullification.

Gastor'nis, a genus of fossil birds of the epyornis family, whose remains, indicating several species, have been found in the Eocene rocks of both England and France. They were birds of the size of an ostrich, with long legs, weak wings, and little if any power of flight.

Gastræa, găs-trē'a, a hypothetical primitive animal consisting simply of a sac or stomach, with an ectodermal and endodermal layer of cells. This simple organism, to which the embryonic gastrula-stage (see EMBRYOLOGY) is the nearest modern approach, and was regarded by Hæckel as recapitulative of the primitive gastræa, Hæckel assumes to have been the first animal generated on the earth, and the germ from which the whole animal kingdom with its infinite diversities was gradually evolved. His hypothesis, called the Gastræa theory, asserted that there must have been many species, families, etc., of these primitive organisms, whence all the *Metazoa* have been evolved. These generalizations were announced by Hæckel in 'Die Gastræatheorie, die Phylogenetische Classification des Thierreichs und die Homologie der Keimblätter,' published at Jena in 1874, and have since been extensively considered in all works on embryology.

Gastrec'tomy, the removal of a part or the whole of the stomach-wall. It is performed for the cure or relief of deep ulcerations, cancerous growths, or contractions of the wall that cause serious obstruction.

Gastric Juice, the secretion of the stomach, is in man a clear almost colorless fluid of acid reaction, containing one half of 1 per cent

solids. The amount secreted varies with the demand, but approximates 1,600 cubic centimetres in 24 hours. In health secretion takes place only under the stimulus of food. Hydrochloric acid, the chief constituent, is present in one or two parts per thousand. During the first stage of digestion it is all combined with the food, but later it is found free. The other important ingredients of this secretion are pepsin, a ferment that has the power of converting albuminous foods into forms that can be absorbed and assimilated; and rennin, a ferment that causes coagulation of milk by converting the casein, one of the milk proteids. Inorganic salts, the alkaline chlorides and phosphates, and phosphates of calcium, magnesium, and iron constitute most of the solids.

Gastritis, găs-trī′tĭs, a general term that includes all strictly inflammatory diseases of the stomach. Phlegmonous gastritis is a very acute, fatal, but rare disease that starts in the deeper layers of the stomach-wall and results in an abscess. Acute gastritis or acute gastric catarrh is an acute inflammation of the lining mucous membrane. The membrane becomes swollen, is covered by a coating of tenacious mucus, and tends to bleed at minute points. Errors in diet, either by over-indulgence or the ingestion of improper food, is the most frequent cause of the malady. Certain chemicals and drugs, very hot food or liquid, foreign bodies, and unripe fruits may cause the irritation. The symptoms depend on the severity of the inflammation, the milder forms being spoken of as sub-acute. Frequently premonitory symptoms, such as a feeling of fulness or tenderness, or the eructation of gases, may be noticed, and may be soon followed, in the more severe cases, by nausea, vomiting, and a rise of temperature, accompanied by painful thirst. If the retching or vomiting of mucus continues, there is apt to be great weakness and prostration. The duration of the disease under proper treatment is seldom over three or four days. The stomach should be given absolute rest for 24 hours, or even longer if nausea or retching continue. The intense thirst may be relieved by small pieces of ice, but not even the drinking of water is permitted. Rest in bed may be indicated in the more severe cases and, if so, hot poultices applied to the stomach region relieve some of the distressing symptoms. Drugs are of little value except to quiet excessive vomiting. Toxic gastritis is that form caused by the ingestion of corrosive and irritating drugs and chemicals. It is a severe form of acute catarrh, with the added effect of the particular poison taken. Strong acids and corrosives cause death of the deeper tissues, with ulceration and even perforation of the wall. The treatment depends upon the poison taken, but dilution by the imbibing of demulcent drinks is usually of value if sufficiently early. Chronic gastritis or chronic gastric catarrh is a chronic inflammatory change in the mucous membrane of the stomach. It is the most wide-spread of maladies, affecting all classes and ages. Not uncommonly successive attacks of acute gastritis, even in early life, start those progressive changes that sooner or later make themselves known as chronic catarrh. The most common cause is the repetition of insult to the stomach in food, both as to quantity and quality, and in drink irritating from high temperature or presence of alcohol. Other causes may operate, such as venous congestion from disease of the heart, liver, and spleen, changes in the blood-elements, and the constant poisoning of infectious diseases.

For an understanding of the symptoms of this affection it must be appreciated that three mechanisms make up gastric digestion — the nervous, the muscular, and the secretory. Deviation from the normal in any one of these is almost certain to act on the others, and when, in addition to these mechanisms, the close relation of the stomach and other digestive organs is considered, a marvelous complex is apparent. The symptoms of a chronic catarrh may be unnoticed, may be merely evidenced by changes due to poor gastric digestion, or interwoven with resulting derangement of all the digestive apparatus. In the early stages the mucous membrane is swelled, the gastric juice still has its normal ingredients and, in addition, the membrane secretes a mucus owing to degeneration of the cells. From this stage to a complete absence of acid, and then of ferments, the change is gradual, the final stage being known as atrophic gastritis. No symptom or group of symptoms is characteristic of the disease, the diagnosis being made with accuracy only by examination of the gastric contents. At one time or another one or more of the following symptoms are noticed. Absence of appetite, bad taste in the mouth, coated tongue, nausea and, occasionally, vomiting, eructation of gases and some liquid, heartburn, and a feeling of fulness or bloating after meals. The presence of inflammation, and the stage, are determined by chemical and microscopical analysis of the contents of the stomach after a test-meal has been eaten. In all except the atrophic stage there is always more or less mucus found mixed with the food. This is the distinguishing feature.

Of itself the disease is not fatal, but severe disorders of nutrition may result that render the sufferer more liable to other diseases.

The treatment consists in correction of the causes as much as possible, particularly in a dietetic regimen free of irritation and of ready digestibility. Lavage or washing of the stomach is of supreme importance where it can be borne. Drugs are of little use except for the relief of distressing symptoms. Where great diminution or absence of acid is found, it may be supplied, but the large amount necessary usually makes the procedure impracticable. Electricity, massage, and hydrotherapy may be beneficial.

Gastros′tomy, the operation of making a more or less permanent opening between the interior of the stomach and the overlying surface, the lining membrane of the stomach being joined to the skin entirely around the margin of the opening. This procedure is undertaken when for any reason the entrance of food into the stomach by natural passage is prevented.

Gastrot′omy, a simple incision of the wall of the stomach, usually undertaken for the exploration of the interior or for the removal of foreign bodies.

Gas′trula. See EMBRYOLOGY; GASTRÆA.

Gatacre, SIR **William Forbes,** English soldier: b. 1843; d. 6 March 1906. He joined the English army in 1862; was instructor of surveying in the Royal Military College in 1875–9;

deputy-adjutant and quartermaster-general in the Hazara Expedition in 1888, and in the Burma, Tonhon Expedition in 1889. He led the British forces in the Sudan in 1898, during the first advance against Atbara, and later commanded a British division in that region during the movement against Khartum and Omdurman. When the war in South Africa broke out he was ordered there and given an important command. He was repulsed at Stormberg with heavy loss. In April 1900 he was recalled to England.

Gatchina, gä'chē-nä. See GATSCHINA.

Gate City, The, a name given to Keokuk, Iowa (q.v.), and to Atlanta, Ga. (q.v.).

Gate of Tears, or **Gate of Mourning,** the Straits of Bab-el-Mandeb, Arabia; the term is an exact translation of the words Bab-el-Mandeb, which have reference to the many shipwrecks which anciently occurred thereabouts.

Gates, Elmer, American psychologist and inventor: b. Dayton, Ohio, 1859. He has done much original work in electric meteorology and has made several electrical mining inventions. He is the author of a system of mind-building and experimental psychology, having four laboratories for experimental research in these fields. Among his works are: 'Psychurgy or the Art of Using the Mind'; 'Art of Mind-Building.'

Gates, Horatio, American military officer: b. Maldon, Essex, England, 1728; d. New York 10 April 1806. He joined the British army early in life; in 1755 was assigned to duty at Halifax, N. S., and later served with Braddock's expedition. In July 1775 Congress appointed him adjutant-general; in 1776 he was given a command in the Northern army, and 2 Aug. 1777 assumed command of the Northern department. He defeated Burgoyne at Saratoga, 7 Oct. 1777, the British general surrounding his army on the 17th. (See SARATOGA, BATTLE OF.) In November of the same year he was appointed president of the new board of war and ordnance; and in 1778, while holding that post, sought with the aid of his friends in Congress to supersede Washington as commander-in-chief. This action soon brought him into discredit, and he resigned from active service. In June 1780 he again entered the army, becoming commander of the troops in North Carolina. On 16 August of that year, his army was defeated near Camden, S. C. He was soon afterward suspended from duty, but reinstated in his command in 1782 after the capture of Cornwallis.

Gates, Lewis Edwards, American educator and critic: b. Warsaw, N. Y., 23 March 1860. He is a brother of M. E. Gates (q.v.). He was graduated at Harvard 1884, instructor in forensics there 1884–7, instructor in English 1890–6, then becoming assistant professor of English. He is a frequent contributor of critical articles to the magazines. He has published: 'Selections from Jeffrey' (1894); 'Selections from Newman' (1895); 'Selections from Matthew Arnold' (1898); 'Three Studies in Literature' (1899); 'Studies and Appreciations' (1900).

Gates, Merrill Edward, American educator: b. Warsaw, N. Y., 6 April 1848. He was graduated at the University of Rochester 1870, was principal of the Albany Academy 1870–82, president of Rutgers College 1882–90, and president of Amherst College 1890–9. He has been very active in promoting Civil Service measures, and ballot reform. He was made chairman of the United States Board of Indian Commissioners 1884, and was president of the American Missionary Association 1893–8. He has published: 'Athens and the Greeks of To-day'; 'Sidney Lanier, Poet and Artist'; 'The Debt the School Owes the State'; 'Land and Law as Agents in Educating the Indians'; 'International Arbitration'; etc.

Gates, SIR Thomas, English colonial governor of Virginia: d. after 1621. He sailed from England in May 1609, in charge of a colony of 500 emigrants to the New World, but his vessel, the Sea Venture, was stranded on the rocks of Bermuda. Here the passengers built two new ships and finally reached Virginia in May 1610. Gates went to England in the meantime and returned in 1611 with 300 more emigrants. He was made governor the same year and held that office till 1614, when he returned to England.

Gatesville, Texas, city and county-seat of Coryell County, on the St. Louis S. R.R., 80 miles north of Austin. It is situated in the fertile valley of the Leon River, and has considerable agricultural, stock-raising, and produce-shipping interests. Pop. (1900) 1,865.

Gath. See TOWNSEND, GEORGE ALFRED.

Gath (Heb. «wine-press»), one of the five cities of the Philistines which were presided over by so many princes or lords from the time of Joshua to a comparatively late period. It was situated on the borders of Judah, and was in consequence a place of much importance in the wars of the Jews and the Philistines. It is stated in Joshua that Gath was one of the cities in which, at the time of the conquest, there still remained some of the ancient Anakims or giants, and they appear to have perpetuated the race here till much later times, for it was from Gath that the renowned Goliath issued. The exact site of the ancient city cannot be determined with any degree of certainty, but some identify it with the eminence Tell-es-Sâfieh, about midway between Ekron and Ashdod.

Gath'mann Gun. See ORDNANCE.

Gatineau, gä-tē-nō, a river of Canada, in the province of Quebec, rising in a large lake of the same name, from which it flows south, and falls into the Ottawa opposite the town of Ottawa. Its total length is 450 miles.

Gatling, Richard Jordan, American inventor: b. Hertford County, N. C., 12 Sept. 1818; d. New York 1903. While a boy he assisted his father in perfecting a machine for sowing cotton seed, and another for thinning out cotton plants. Subsequently he invented a machine for sowing rice. Removing to St. Louis in 1844, he adapted this invention to sowing wheat in drills. For several winters he attended medical lectures in Cincinnati, and in 1849 removed to Indianapolis, where he engaged in railroad enterprises and real estate speculations. In 1850 he invented a double-acting hemp brake, and in 1857 a steam plow, which, however, he did not bring to any practical result. In 1861 he conceived the idea of the revolving battery gun which bears his name. Of these he constructed six at Cincinnati, which were destroyed by the burning of his factory. Afterward he had 12 manufactured elsewhere, which were

used by Gen. Butler on the James River. In 1865 he improved his invention, and in the year following, after satisfactory trial, it was adopted into the United States service. It has also been adopted by several European governments. At the time of his death he was perfecting a few business formalities prior to placing his new motor plow on the market. Although best known as the inventor of a terrible death-dealing weapon, he was the gentlest and kindliest of men. The sight of returning wounded soldiers early in the Civil War led him to consider how war's horrors might be alleviated. By making war more terrible, it seemed to him nations would be less willing to resort to arms, and he accordingly devoted himself to the study of ordnance and ballistics, with this end in view.

Gatling Gun. See ORDNANCE.

Gatschet, Albert Samuel, American linguist: b. Berne, Switzerland, 3 Oct. 1832. He was educated at the universities of Berne and Berlin, and removing to New York in 1868 made a special study of the languages of the American Indians. In 1879 he became connected with the Bureau of American Ethnology. He is the author of: 'The Klamath Indians of Southwestern Oregon'; 'A Greek Migration Legend'; etc.

Gatty, Margaret Scott, English writer for young people: b. Burnham, Essex, England, 3 June 1809; d. Ecclesfield, Yorkshire, 3 Oct. 1873. She was married to Rev. Alfred Gatty in 1839. Her career in letters was begun with 'The Fairy Godmother and Other Tales' (1851); but 'Parables from Nature' (1855–71) was the most popular and still holds its place in public favor. She edited 'Aunt Judy's Magazine' (1866–73).

Gauchos, gow'chōz, hybrid inhabitants of South America, mostly cattle-raisers of nomadic habits. They are natives of the pampas, and descendants of Spaniards and Indians. The white strain has largely faded out from them, and a modified Indian type has been developed which has an ethnological interest. As a distinct people, however, they may be said to be disappearing. They are now mainly confined to the Chaco region. Many of them possess figures and bearing which show a proud descent. They wear a costume picturesque in fashion and color, and their skill as horsemen and in using the lasso and bolas is remarkable. They subsist almost wholly on meat, and are noted for their hardiness, bravery, and free mode of existence.

Gauden, gâ'dĕn, **John,** English bishop: b. Mayland, Essex, 1605; d. 20 Sept. 1664. In the early part of his life he belonged to the popular party. After the outbreak of the civil war, he hesitatingly submitted to the Presbyterian discipline, omitted the liturgy from the Church service, and even subscribed to the covenant, although he secretly wrote a treatise against it. After the Restoration he was appointed chaplain to Charles II., and successively created bishop of Exeter and of Worcester. He claimed the authorship of the 'Eikon Basilike,' or the 'Portraiture of his Sacred Majesty in his Solitudes and Sufferings,' a work which was once almost universally attributed to Charles himself, and which in one year went through 50 editions. Hallam and Sir James Mackintosh pronounce his claim valid. Other works of his are: 'Cromwell's Bloody Slaughter House' (1660); 'Tears of the Church' (1659). See EIKON BASILIKE.

Gauge, gāj, the name of many different instruments and appliances used for measuring various dimensions, forces, etc. The various kinds of gauge are distinguished by means of special names indicating the use to which they are applied. Among the most important contrivances of this nature are the instruments fixed to engine boilers for registering the force of the steam and the level of the water. In one of its simplest forms the pressure or steam gauge consists of a bent siphon-tube, with two unequal legs, partly filled with mercury. The top of the shorter limb is connected to a short pipe, which enters that part of the boiler which contains the steam; the other end is open to the atmosphere. A stop-cock is generally placed between the gauge and the boiler, so that it may be put in communication with the boiler at pleasure. When the stop-cock is open, the steam, acting on the mercury in one leg of the gauge, presses it down, and the mercury in the other leg rises. The difference between the two columns is the height of mercury which corresponds to the excess of the pressure of the steam in the boiler above the pressure of the atmosphere. For high-pressure engines, however, the steam-gauge usually works in the manner of an aneroid barometer, a pointer moving on a circular scale under the influence of the motion of a corrugated diaphragm; or, as in the Bourdon gauge, the tendency of a bent tube to straighten itself under the influence of the steam pressure communicates movement in a similar manner to a pointer or index hand. The water-gauge is a vertical glass tube called a gauge-glass, communicating above and below with the boiler. The gauge-glass is not fixed directly to the boiler, but to a brass column known as the gauge-column, communicating with the boiler by two copper tubes of considerable length, the upper leading to the steam space and the lower to the water space. These tubes are fitted with cocks or valves. Two gauge-glasses of different lengths are sometimes fitted to the one column. Gauge-cocks are used as checks on the water-gauges. There are usually three of them on the front of the boiler, one at the normal level of the water, one above, and one below. As applied to railroads (q.v.) gauge signifies the distance between the centres of each pair of rails, which in the ordinary or narrow gauge is 4 feet 8½ inches. The broad gauge of the Great Western Railway of England was formerly 7 feet; the Irish, Indian, and Spanish gauge is 5 feet 6 inches. Special narrow gauges have been adopted for certain lines, especially for mountain and mineral lines, such as the 3 feet 6 inch Norwegian gauge. Gauge is also the name applied to various contrivances for measuring any special dimension, such as the wire-gauge, an oblong plate of steel, with notches of different widths cut on the edge, and numbered, the size of the wire being determined by trying it in the different notches till one is found which it exactly fits. The thickness of sheet-metal is tried by a similar gauge.

Gau'gengigl, Ignaz Marcel, American painter: b. Passau, Bavaria, 1856. He was a pupil of Diez and Raab at Munich, and set up a

studio in Boston, Mass., in 1879. He paints preferably interiors, introducing numerous small figures. Among his picture titles are: 'My Studio,' 'The Duel,' and 'The First Hearing.'

Gaul, gâl, **Alfred Robert,** English composer and organist: b. Norwich, England, 1837. He was chorister and assistant organist of Norwich Cathedral 1846–59 and subsequently organist of St. Augustine's Church, Edgbaston, Birmingham. He has composed an oratorio, 'Hezekiah'; the cantatas 'Ruth' (1881), 'First Psalm,' 'Ninety-sixth Psalm,' 'Holy City' (1882), a widely popular work; 'Passion Music'; 'The Ten Virgins' (1890), dedicated to the choirs of America; 'Song of Life'; 'Una'; etc.

Gaul, Gilbert William, American artist: b. Jersey City, N. J., 31 March 1855. He was a pupil of J. G. Brown, and studied at the National Academy of Design, exhibiting first there in 1872. He was elected associate in 1880 and National Academician 1882. He is a scene painter often choosing battle subjects, and has won several medals, including two at the World's Columbian Exposition 1893. Among his works are: 'Indian Girl'; 'Coquette' (1880); 'Old Beau' (1881); 'Charging the Battery'; 'News from Home' (1882); 'On the Outpost' (1883); 'On the Lookout'; 'Guerrillas' (1885).

Gaul, Gallia, the country of the Gauls which extended in the times of the Romans, from the Pyrenees to the Rhine, and on the side of Italy, beyond the Alps to the Adriatic. It was divided into Gaul on this side (the Italian side) of the Alps (Gallia Cisalpina), and Gaul beyond the Alps (Gallia Transalpina).

Gallia Cisalpina extended from the Alps to the Adriatic Sea, and consequently comprised all Upper Italy as far as the Rubicon and Macra, on account of its adoption of the Roman toga was called *Gallia Togata.* It was divided into Liguria; Gallia Transpadana; Gallia Cispadana. Liguria was inhabited by the Ligurians, Gallia Transpadana principally by the Taurinians, Insubrians, and Cenomani; Gallia Cispadana by the Boii, Senones, and Lingones, all of them nations of Gallic descent.

Transalpine Gaul was also called *Gallia Comata* in distinction from *Gallia Togata,* because the inhabitants wore their hair (*coma*) long, or *Gallia Braccata*, because, particularly in the southern parts, they wore a peculiar kind of breeches (*braccoe*). Caesar, who conquered Transalpine Gaul at a later period, found it divided into three parts: Aquitania, extending from the Pyrenees to the Garonne, chiefly occupied by Iberian tribes; Gallia Celtica, from the Garonne to the Seine and Marne; Gallia Belgica, in the north, extending to the Rhine.

The Gauls were the chief branch of the great original stock of Celts. On the whole, a great resemblance appears to have existed among all the Celts; and although they were divided into numerous tribes, there were but few branches that were perceptibly different from each other. It is probable that coming from the east, they took their way along the south side of the Danube, having the numerous nation of the Thracians in their rear and the Germans on their side; but the period of this event is so remote that we cannot even venture a conjecture in regard to it.

A too great population (which is not uncommon in half savage and partly nomadic nations whose means of supplying their wants are very imperfect, and who require a great extent of country), and the pressure of German and Thracian tribes, caused general migrations among the Gauls about 397 B.C. Colonies from many tribes took their course over the Alps into Italy, and eastwards along the Danube. This passage of the Celtic Gauls over the Alps first brings that nation into the region of history.

Our accounts of the course of the eastern Gauls along the banks of the Danube are very imperfect; this, however, is evident, that their movements occasioned the migrations of the whole nations. One hundred years after the burning of Rome, the eastern Gauls, from 280–278 B.C., made three destructive irruptions into Macedonia and Greece, which had already been depopulated by former wars. Ptolemy Ceraunus, king of Macedonia, and Sosthenes, the commander of the army, fell in battle, and Greece trembled. But in an attack on the temple of Apollo at Delphi (which contained immense treasures, but was protected by its situation) the terrors of religion and the assaults of the elements (tempest and hail-storms) came over them; they were defeated, and hunger, cold, and the sword of the Greeks completed their destruction. Several tribes pursued their course into Asia Minor, where, under the name of Galatians, they long retained their national peculiarities, and preserved their language even to the latest period of the empire. The reaction of these migrations upon Gaul itself appears to have been considerable. The Gauls along the banks of the Danube and in the south of Germany disappear from that time. Tribes of German origin occupy the whole country as far as the Rhine, and even beyond that river. The Belgæ, who were partly German, occupied the northern part of Gaul, from the Seine and Marne to the British Channel and the Rhine, from whence colonists passed over into Britain, and settled on the coast districts. The Celtæ in Gaul, attained a higher degree of cultivation, to which probably their intercourse with the Greeks in Massilia (Marseilles), whose letters they used in writing their own language, and with the Carthaginians, in whose armies they frequently served as mercenaries, contributed in a great measure. But they were then hardly able to resist the Germans who lived on the other bank of the Rhine. Their kinsmen, the Britons, who painted their bodies, fought from chariots, and practised polygamy, were more fierce than the Gauls.

Meanwhile the Gauls of Cisalpine Gaul had taken up their residence in the fertile plains of Upper Italy. Rome trembled at the irruption of these barbarians into Italy; but Caius Marius saved the republic. In two bloody battles, at Aix (Aquæ Sextiæ) in 102, and at Vercelli in 101 B.C., he destroyed these nations. Only that portion of them which had remained in Gaul to await the issue of the expedition escaped the general ruin. Forty-three years after this event Caius Julius Cæsar received the proconsulship over the countries bordering on Gaul.

He resolved to subject all Gaul, and executed his purpose in less than nine years (58-50 B.C.), in eight bloody campaigns.

The religion of the Druids, being suppressed in Gaul by Tiberius and Claudius, gradually retreated into Britain, where, particularly on the small islands near the British coasts, the priests established their mysterious rites, of which in ancient times strange and dreadful accounts were current. The Britons also were soon conquered by the Romans. After the extinction of the family of the Cæsars, the Gauls once more made an attempt to recover their liberty by the aid of the Germans, but in vain. After this last effort they gradually became Roman citizens, and so entirely Romanized that even their ancient language, the Celtic, was supplanted by a corrupt Latin dialect, retaining, however, a considerable number of Celtic words, especially as roots, which, intermingled with Franco-Germanic words, formed the modern language. About the year 486 the Franks subdued the greater part of Gaul, and put a period to the dominion of the Romans in that country.

Gauley Bridge, W. Va., an important strategical point at the head of Kanawha Valley, and one of the three passes of the Alleghanies. It was the objective point of Gen. Cox in his campaign from the Ohio in July 1861, and was occupied by him and strongly fortified after he had driven Gen. Wise from the valley and eastward to Lewisburg. After the battle of Carnifax Ferry (q.v.) Rosecrans advanced to Sewell Mountain, confronted Gen. Lee, who had assumed command of the Confederate forces, for several days, and then fell back to Gauley Bridge disposing the greater part of his army from 5 to 12 miles in front of it, along the Lewisburg road. With Lee's assent Gen. Floyd, with about 5,000 men, crossed New River and moved down its south side to Cotton Hill, a bold height in the angle formed by the junction of the New and Gauley rivers. He got artillery in position commanding Gauley Bridge, the ferry across the Gauley, and the road leading to Rosecrans' camps. On the morning of 1 November the artillery opened fire, sunk the ferryboat and, with sharpshooters beyond New River, stopped the passage of Rosecrans' supply-trains. The contest on both sides, with artillery and musketry, across the narrow river was severe, and ended only by darkness. The next day it was resumed and continued for ten days, the trains moving only by night. Meanwhile Rosecrans was preparing to capture Floyd by moving a force on his left and rear, a movement in which Cox, who was in command at Gauley Bridge, was to co-operate. On the 10th Cox crossed his brigade in boats over New River, at and near its mouth, and drove Floyd from Cotton Hill, after a sharp fight of two days. The co-operative movement on Floyd's left and rear failed. Floyd became aware of it, and on the 12th retreated as rapidly as possible, abandoning wagons and supplies, and pursued as far as Fayetteville. He continued his retreat to Dublin, on the Virginia and Tennessee Railroad.

E. A. Carman.

Gauley Mountains, W. Va., a range in Kanawha and Fayette counties, extending eastward for about thirty miles, from the Kanawha River near Charleston, and divided near the middle into two ridges between which flows the Gauley River.

Gauley River, W. Va., an affluent of the Great Kanawha River. It rises in the Black Mountains in Pocahontas County, and after a course of 75 miles, first westward between the Gauley Mountains (q.v.), then southward, joins New River which, from the point of junction at Gauley Bridge, is called the Great Kanawha.

Gault, gâlt (originally a local name in Cambridgeshire, England, for clay), one of the subdivisions of the Cretaceous system (q.v.). The gault is a stiff, bluish-gray clay, which here and there contains indurated nodules and septaria. Now and again it becomes somewhat calcareous, or sandy and micaceous. In some parts of Sussex a band of phosphatic nodules occurs at its base. The deposit is of variable thickness — reaching in some places over 300 feet, while occasionally it hardly attains a greater thickness than 50 feet, and forms a well-marked geological horizon — forming the bottom member of the Upper Cretaceous rocks. It is abundantly fossiliferous, the remains being almost exclusively marine, only a few drifted land-plants having been met with. The gault is extensively employed in the manufacture of bricks and tiles; it forms a retentive and rather unproductive soil.

Gaulthe'ria. (named for Dr. Gaultier of Quebec), a large genus of evergreen shrubs, or under-shrubs, with small, axillary, nodding flowers, white, pink or red, having a corolla and calyx with five divisions, the former urn-shaped or companulate; and a berry-like fruit, red or blackish, consisting of a fleshy calyx enclosing a capsule. There are about 100 species, found mostly in the Andes, a few being Asiatic and North American. Of the latter, the best known is *G. procumbens,* the familiar aromatic or creeping wintergreen, known in different localities as checkerberry (a name sometimes applied to *Mitchella repens*), boxberry, spice-berry, ground-berry, mountain tea, and partridge-berry (q.v.). This plant is found in cool, damp woods, chiefly under the shade of evergreens, in Canada and the United States, extending southward along the Alleghanies. The leaves are mostly clustered at the top of branches rising from creeping stems; the flowers are white, the berries red and spicy, with a flavor (also characterizing the leaves) resembling sweet birch. The leaves of *G. procumbens* and *G. hispidula* contain an aromatic oil which has a greater density than any other essential oil. It contains about 10 per cent of a terpene called gaultherilene and about 90 per cent of methyl salicylate. Oil of wintergreen is colorless when fresh, but later becomes yellowish, and is used for flavoring candy and for disguising the taste of unpleasant medicines. This oil may be extracted from a few other plants, particularly sweet birch (*Betula lenta*). See Wintergreen.

Gaur, gowr, a very large, fierce, and untamable ox (*Bos gaurus*) found in the forests of India and Burma, called «bison» by Anglo-Indian sportsmen, and distinguished by the Malays into two varieties called «sladang» and «sapio.» Old bulls are sometimes six feet high at the shoulders, making them the largest of wild oxen. The horns spread laterally and curve

upward to the length ordinarily of 20 to 30 inches, and are large and flattened, while the ridge of the forehead between them leans forward decidedly and is covered with a mop of gray hair. The general color is smooth, shining, blackish brown, with the feet white. This magnificent animal, which is semi-domesticated to some extent in northern India and never in the south, wanders about the jungles in small shy herds under the leadership of a powerful bull, as is the habit of forest oxen generally. It is one of the foremost objects of rifle sport in India, and the best accounts of its habits are to be found in the books of sportsmen-writers, such as Baker, Kinloch, Shakspear, Hornaday, etc. The animal must be followed on foot, in which the aid of good trackers is essential; and when it has been overtaken it is usually hidden in some dense cover, whence it is likely to charge without warning. Its flesh is excellent. See GAYAL.

Gauss, Karl Friedrich, kärl frēd'rĭн gows, German mathematician: b. Brunswick 30 April, 1777; d. Göttingen 23 Feb. 1855. At 18, while a student at Göttingen, he solved a problem (that of the division of the circle into 17 equal parts) which had occupied geometers from the time of Euclid. In 1801 was published his 'Disquisitiones Arithmeticæ,' treating of indeterminate analysis or transcendental arithmetic, and containing, in addition to many new and curious theorems, a demonstration of the famous theorem of Fermat, concerning triangular numbers. He calculated, by a new method, the orbit of the newly discovered planet Ceres, and afterward that of Pallas, for which he received from the French Institute in 1810 the medal founded by Lalande. In 1807 he became professor of mathematics and director of the observatory at Göttingen, a position which he held till his death. In 1821, being charged by the government of Hanover with the triangulation of that country and the measurement of an arc of the meridian, he rendered the most distant stations visible by means of the heliotrope, an instrument of his invention for reflecting solar light; and in connection with Weber made valuable investigations concerning terrestrial magnetism. He was pronounced by Laplace to be the greatest mathematician in Europe. Among the more celebrated of his works are 'Theoria Motus Corporum Cœlestium' (1809); 'Intensitas Vis Magneticæ Terrestris' (1833); 'Dioptrische Untersuchungen' (1841); and 'Untersuchungen über Gegenstände der höheren Geodesie' (1844).

Gautama, gow'ta-ma, or **Gotama,** the patronymic of several celebrities connected with Hindu Vedaism, and of Siddartha Gautama, the founder of Buddhism. See BUDDHA.

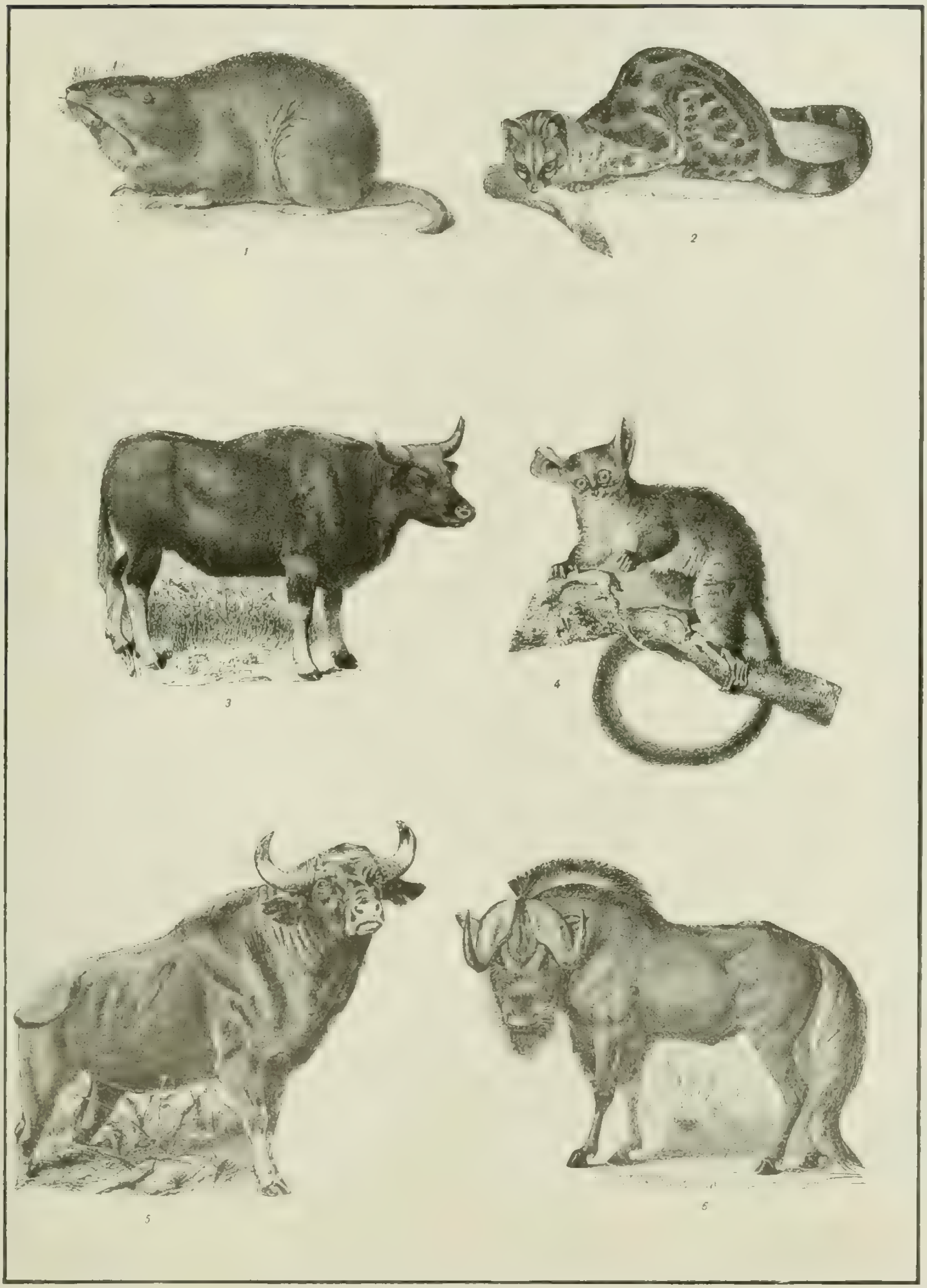
Gautier, Emile Théodore Léon, ā-mēl tā-ō-dōr lā-ôn gō-tē-ā, French scholar and critic: b. Havre 8 Aug. 1832. He held official positions connected with the schools and libraries of his native place till his growing eminence as a writer brought him to Paris. His works, which place him among the very foremost authorities on mediæval European literature, include: 'Definition Catholique de l'Histoire' (1860); 'Benoit II.' (1863); 'Etudes litteraires pour la defense de l'Eglise' (1864); 'Epopées françaises' (1866–7); 'Vingt nouveaux portraits' (1878); 'La Chevalerie' (1884); 'Histoire de la poésie religieuse dans les cloîtres des IXe et XIe siècles' (1888); 'Etudes et tableaux historiques' (1890).

Gautier, Judith, zhü-dēth, **French novelist,** daughter of Théophile Gautier (q.v.) and Carlotta Grisi, the famous Italian singer: b. Paris, France, 1850. She married Catulle Mendès, but was divorced. Her first work, under the name "JUDITH WALTHER," was 'The Book of Jade' (1867), a collection of prose and verse translated from the Chinese; it was followed by 'The Imperial Dragon' (1869), a Chinese romance, signed "JUDITH MENDÈS"; 'The Usurper,' a Japanese romance, crowned by the French Academy in 1875; 'Lucienne' (1877); 'The Cruelties of Love' (1878); 'Isoline' (1881); 'Poems of the Dragon Fly' (1884), adapted from the Japanese; 'Potiphar's Wife' (1884), a Persian romance; 'The Merchant of Smiles' (1888), a drama adapted from the Chinese; 'The Marriage of Fingal' (1888), a lyric poem.

Gautier, Théophile, tā-ō-fēl, French poet and prose writer: b. Tarbes, France, 31 Aug. 1811; d. Paris, 23 Oct. 1872. He was educated at the grammar school of his native town, and afterward at the College Charlemagne in Paris. He applied himself at first, but without much success, to painting; and then turned to literature. In verse he published: 'Albertus' (1830); 'Comedy of Death' (1832); 'Enamels and Cameos' (1856); his best poetry; etc. His novels and short stories include: 'Young France' (1833); 'Mademoiselle de Maupin' (1835); 'Fortunio' (1838); 'A Tear of the Devil' (1839); 'Militona' (1847); 'The Tiger's Skin' (1852); 'Jettatura' (1857); 'Captain Fracasse' (1863); 'Handsome Jenny' (1865); 'Spirite' (1866); etc. He was drawn early to feuilleton writing, and for more than 30 years contributed to the Paris newspapers criticisms on the theatre and the salon. He also wrote: 'Journey in Spain' (1843); 'Zigzags' (1845); 'Constantinople' (1854); 'Journey in Russia' (1866); etc., which rank among the most delightful books of modern travel. Still other works were an enlarged edition of 'Enamels and Cameos' (1872); 'The Grotesques' (1844); 'History of Dramatic Art in France' (1859); 'Balzac' (1858); 'Private Menagerie' (1869), biographical: 'History of Romanticism' (1872); 'Literary Portraits and Souvenirs' (1875); 'The East' (1877), the last two being posthumous. Gautier's whole philosophy is a philosophy of paradox, his ideal of life hardly more than a picturesque viciousness. His besetting sin was a desire to say something clever and wicked to shock the Philistines. See lives by Feydeu (1874); Bergerat (1878); Richet (1893); Brunetière, 'Evolution de la poésie lyrique' (1894).

Gauze, a light, transparent silk stuff, or sometimes a fabric of silk and cotton or silk and hemp, or of other material. In weaving gauze, at every third cast of the shuttle the warp-threads are turned or twisted after receiving the woof from right to left, and the reverse, alternately, between each throw of the shuttle, so that the weft-threads are separated from each other, the slight texture being thus produced. Gauzes are either plain or figured. The latter are worked with flowers of silver or gold, on a silk ground, and are chiefly made in China. For antiseptic purposes, etc., cotton

GAUR, GENET, ETC.



1. Gopher (Geomys bursarius).
2. Genet (Viverra genetta).
3. Gayal (Bos frontalis).
4. Galago (Otolicnus galago).
5. Gaur (Bos gaurus).
6. White-tailed Gnu (Connochætes gnu).

gauze is specially made for the use of surgeons. Special fabrics to which the name is given are also manufactured to be made into light underwear. The term has further been extended to any slight open material, as bolting-cloth and wire-cloth for various purposes. A wide-meshed, unsized cheese-cloth, which is called gauze, is considered by surgeons to be the cheapest and most convenient material for dressing wounds, being comfortable and absorbing fluid without disagreeable matting.

Gavarnie, Cascade de, France, a waterfall in the Cirque de Gavarnie, Pyrenees. It is the second highest in Europe, being 1,385 feet in height.

Gavarnie, Cirque de, France, a natural amphitheatre in the Pyrenees. It is 2¼ miles in width and 5,380 feet in height.

Gavazzi, gä-vät'sē, **Alessandro,** Italian reformer: b. Bologna, Italy, 21 March 1809; d. Rome, 9 Jan. 1889. At 16 he became a monk of the Barnabite order, and subsequently was appointed professor of rhetoric at Naples, where he speedily acquired a reputation as an orator. On the ascension of Pius IX. to the papal chair, he devoted himself to the diffusion of political enlightenment and patriotic aspirations among the masses of the Roman population. Later he forsook the papal ranks and to Gavazzi's fervid and patriotic oratory may be attributed, in no slight degree, the universal spirit of self-sacrifice evoked throughout Italy during this period of her history. He was called Peter the Hermit of the national crusade. On the establishment of the republic at Rome he was appointed almoner-in-chief to the national army. Rome having fallen, Gavazzi went to England, where he delivered numerous addresses and lectures illustrative of the political and religious aims of his country. He twice visited the United States. He was the founder of the Free Christian Church of Italy in 1870, and author of 'Recollections of the Last Four Popes' (1859); 'No Union with Rome' (1871), etc.

Gaveston, găv'ĕs tŏn (Fr. gä-vĕs-tôṅ), **Piers,** favorite of Edward II., king of England: d. 19 June 1312. He was a Gascon by birth, and on account of his father's services to Edward I. was chosen companion to the Prince of Wales, over whom he acquired a complete and very mischievous ascendency, wasting his resources, and breeding dissension between him and his father. Edward I. banished him in 1307, but died the same year, and Edward II. at once recalled him, made him Earl of Cornwall, and gave him in marriage his niece, Margaret de Clare. Intoxicated with his elevation and honors Gaveston became intolerably insolent and exasperated the nobles. He was again banished, again recalled, and, the barons having declared war, was captured, and executed near Warwick.

Gavial, gā'vĭ-al, or **Ghavial,** the common crocodile of northern India (*Gavialis gangeticus*), characterized by its greatly prolonged and slender snout, a peculiarity which increases with age and varies according to sex. In the male the nose is very much swollen, and can be inflated like a bag when the nostrils (at the extremity) are closed. The teeth are very numerous,— usually more than 100. The cranial structures accompanying these peculiarities indicate a separate family (*Gavialidæ*), which first appears in the Upper Cretaceous, and has had many fossil genera and species, among them an Asiatic monster (*Rhamphosuchus crassidens*) of the Pliocene which was 50 feet in length. The gavial inhabits chiefly the basins of the Ganges, Indus and Brahmaputra, and reaches a length of 20 to 25 feet. In the Ganges it is of a deep sea-green color above, with numerous irregular brown spots, smallest and thickest about the jaws, and below pale yellowish white. It feeds on fish and is harmless, in spite of its huge size. Its habits are little known; and still less is known of a closely related but smaller gavial (*Tomistoma schlegeli*) of Borneo, and Sumatra.

Gavotte, ga-vŏt, or **Gavot,** originally a dance of the Gavots or people of the Gap, department of the Upper Alps in France. It was a peasant dance, not unlike a minuet, and happily uniting liveliness with dignity. It was popular from the 16th to the 18th century, and at one period was in favor at court. After undergoing modifications it fell into disuse. The name is also given to a kind of music at first intended for such a dance. It came into great favor and was a frequent movement in suites, sonatas, etc., having been used by Bach and other great composers. In our time it has again become popular.

Gay, Delphine. See GIRARDIN, MADAME DE.

Gay, Edward, American painter: b. Dublin, Ireland, 1838. He came to the United States in 1838, studied art in Albany, N. Y., and as a pupil of Schirmer and Lessing at Carlsruhe; established a studio in New York; and was elected an associate of the National Academy of Design in 1868. In 1887 he obtained the Metropolitan prize for his picture 'Broad Acres,' now in the Metropolitan Museum, New York. His works have been prominent in exhibitions of the Water Color Society and the National Academy, and include: 'Washed by the Sea'; 'The Suburbs'; 'Where Sea and Meadow Meet' (Executive Mansion, Albany); 'The Waving Grain,' etc.

Gay, John, English poet: b. Barnstaple, Devonshire, England, baptized 16 Sept. 1685; d. London 4 Dec. 1732. In 1713 he published his 'Rural Sports,' which he dedicated to Pope. This compliment introduced them to each other, and proved the foundation of a friendship which lasted for life. In 1714 his caricature of Ambrose Philips' pastoral poetry was published under the title of 'The Shepherd's Week.' His pleasant mock-heroic poem, entitled 'Trivia, or the Art of Walking the Streets of London,' was published in 1715, and in that year also was acted his burlesque drama of 'What d'ye Call It?' followed by a farce, in conjunction with Pope and Arbuthnot, called 'Three Hours after Marriage.' The production of this play altogether failed. In 1720 he published his poems by subscription, in 1723 his tragedy, 'The Captives,' and in 1726 his well-known 'Fables.' His 'Beggar's Opera' was first acted in 1727 at Lincoln's Inn Fields, where it ran for 63 nights, but the lord-chamberlain refused to license for performance a second part entitled 'Polly.' The latter part of his life was spent in the house of the Duke of Queensberry, where he wrote his sonata 'Acis and Galatea' and the opera 'Achilles.' He was interred in Westminster

Abbey, where his monument bears a flippant epitaph taken from one of his letters to Pope. Among his smaller pieces, his two ballads of 'Black-eyed Susan' and ''Twas when the Seas were Roaring,' are much admired.

Gay, Sidney Howard, American journalist and author: b. Hingham, Mass., 22 May 1814; d. New Brighton, Staten Island, N. Y., 25 June 1888. Unwilling to take the oath to support the Constitution of the United States, which fostered and protected slavery, he gave up a legal career and devoted himself to anti-slavery journalism and lecturing. He became, in 1842, editor of 'The Antislavery Standard,' a position he retained till he joined, in 1857, the editorial staff of the New York *Tribune*, of which he was managing editor 1862–6. From 1867 to 1871 he occupied the same position on the Chicago *Tribune*, and for another two years was managing editor of the *Evening Post*. He was the author of Bryant & Gay's 'Popular History of the United States,' and in 1884 wrote the life of James Madison in the 'American Statesmen' series.

Gay, Walter, American artist: b. Hingham, Mass., 22 Jan. 1856. He is a nephew of S. H. Gay (q.v.), and W. A. Gay (q.v.). At 20 he went to Paris, where he studied art under Bonnat, and he has been a frequent exhibitor at the salon. Among his paintings, which have won many medals, are 'Benedicite,' now in the Museum of Amiens, France, 'Las Cigarreras' ('The Cigarette Sellers') in the Luxembourg, Paris; and canvases in the Metropolitan of Fine Arts, New York, the Museum of Fine Arts, Boston, and several noted collections in Europe.

Gay, Winckworth Allan, American artist: b. Hingham, Mass., 18 Aug. 1821. At an early age he became a pupil of Weir, professor of drawing at West Point, subsequently went to Europe, and passed five years there in study, a part of the time under Troyon in Paris. He paints exclusively in landscape. 'A Scene in the White Mountains,' a picture painted for the Boston Athenæum, is a good specimen of his method of treatment of mountain scenery. Some of his best works depict that region. But he has also painted views of Nantasket beach and rocks, which have attracted much attention, and some critics have pronounced coast scenery to be his proper specialty.

Gay-Lussac, Joseph Louis, zho-zĕf loo-ē gā-lü-säk, French physicist: b. St. Leonard, Haute-Vienne, France, 6 Dec. 1778; d. Paris 9 May 1850. In 1804 he was the first to make balloon ascensions for purposes of scientific investigation; became a member of the society of Arcueil, and was introduced to Humboldt, with whom he prosecuted an investigation of the polarization of light and other subjects. He also devoted much of his time to the study of chemistry, and to him we are indebted for the discovery of the hydro-sulphuric and oxy-chloride acids. In 1830 he became a member of the Chamber of Deputies, and in 1839 was created a peer of France. He enjoyed several official appointments, and was professor of chemistry at the Jardin du Roi.

Gay Head, a promontory and lighthouse on the western extremity of Martha's Vineyard, Mass. Lat. 41° 21′, lon. 70° 50′ W.

Gay-Lussite, gā'lŭ-sīt, a native hydrous carbonate of calcium and sodium, Ca CO_3. $Na_2CO_3 + 5H_2O$. It was described by Boussingault from crystals found in a bed of clay in the bottom of a lake near Maracaibo, Venezuela. These are vitreous, white, monoclinic prisms, having a hardness of 2 to 3 and a specific gravity of about 1.94. It also occurs in the waters of a lake near Ragtown, Nevada. It was named after the French chemist, Gay-Lussac. The name «natrocalcite» has been applied to pseudomorphs of calcite, which were supposed to be after gaylussite, but which now seem proven to be after celestite.

Gaya, gī'ä, India, chief town of a district of the same name in Bengal. It is a place of the greatest sanctity, from its associations with the founder of Buddhism, and is annually visited by about 100,000 Hindu pilgrims, who pray for the souls of their ancestors at the 45 sacred shrines within and without the walls. In Gaya proper the Brahmans reside; adjoining is Sahibganj, the trading and official quarter. Six miles south is the village of Buddha-Gaya, the home of Buddha. (See BUDDHISM.) Pop. (1901) 80,383 for the district; city 15,000.

Gayal, gī'al, or **Mithan,** a tame ox (*Bos frontalis*) of northwestern India and the hilly regions of Indo-China, known principally in the herds of the semi-civilized hill-tribes, but which also exists wild in Tenasserim. These cattle are kept for the sake of their beef, gayals never being put to any sort of work, as are humped cattle. This ox is somewhat smaller than the gaur (q.v.), has proportionately shorter legs, rounder and shorter horns, a flatter forehead and greater dewlap. It will interbreed with the gaur and various other bovine species.

Gayarré, gā-ä-rā', **Charles Etienne Arthur,** American lawyer and historian: b. New Orleans, La., 9 Jan. 1805; d. 11 Feb. 1895. He was admitted to the bar in 1829; was several times a member of the Louisiana legislature; deputy State attorney-general (1831); secretary of state of Louisiana (1846–53). Among his works, which deal largely with the history of his native State, are: 'History of Louisiana,' in French (1830); 'Louisiana, its History as a French Colony' (1851); 'Philip II. of Spain' (1866); 'Fernando de Lemos,' a novel (1872).

Gay'ler, Charles, American playwright: b. New York 1 April 1820; d. Brooklyn 28 May 1892. He removed to the West, was a law pupil of Abraham Lincoln, was admitted to practice, in 1848 edited the Cincinnati *Evening Dispatch*, and in 1850 became connected with the New York press, to which he contributed for many years. He wrote for English and American production a large number of plays, according to some statements nearly 400. These include: 'The Heir of Glen Avon,' his earliest attempt, produced in 1839; 'Taking the Chances'; 'Olympiana'; 'The American Cousin at Home' (for E. A. Sothern); 'Night and Morning'; 'With the Tide'; 'Brom Bones'; 'The Connie Soogah'; 'Bull Run'; 'Inflation'; 'Lord Tatters, Irish'; and 'Fritz, our Cousin German,' his most successful work, written for J. K. Emmet and first produced at Buffalo, N. Y., in 1869

Gayley, Charles Mills, American educator: b. Shanghai, China, 22 Feb. 1858. He was

graduated at the University of Michigan in 1878, and became professor of the English language and literature in the University of California in 1889. His publications include: 'Songs of Yellow and Blue'; 'Guide to Literature of Æsthetics'; 'English in Secondary Schools'; 'Classic Myths in English Literature'; etc.

Gaynor, William Jay, American jurist: b. Whitestown, Oneida County, N. Y., 1851. He was for a time a journalist, studied law and in 1875 was admitted to the bar, wrote on legal subjects, and was identified with many cases of importance. In 1893 he was elected a judge of the State supreme court. He became best known through securing the conviction of John Y. McKane of Gravesend for election frauds.

Gayoso, José Brunetti, hō-sā' broo-nĕt'tē gī-yō'sō, DUKE OF ARCOS, Spanish diplomat: b. Madrid, 6 Feb. 1839. He was educated at the University of Madrid, was admitted to the bar, entered the diplomatic service in 1864, and was secretary of legation at various capitals. He became minister plenipotentiary to Bolivia in 1881, to Uruguay in 1889, Chile in 1893, and Mexico in 1898. In 1899 he was appointed Spanish envoy extraordinary and minister plenipotentiary to the United States.

Gaza, gä'zä, **Theodorus,** Greek scholar: b. Thessalonica, Macedonia, about 1400; d. Italy 1478. He fled about 1444 before the Turks to Italy, where he became teacher of Greek at Ferrara, next of philosophy at Rome. Gaza has been warmly praised by subsequent scholars, such as Politian, Erasmus, Scaliger, and Melanchthon. His principal work was a Greek grammar in four books, first published by Aldus Manutius at Venice in 1495. He translated into Latin portions of Aristotle, Theophrastus, St. Chrysostom, Hippocrates, and other Greek writers.

Gaza, gā'za, Syria, an ancient town, capital of the district of the same name, about 3 miles from the mouth of the river Gaza, 50 miles from Jerusalem, on the high road between Egypt and Damascus. The bazaar and markets are of considerable importance. Gaza is a depot for barley, and has many potteries. The district of Gaza occupies the southwest corner of Syria, having the Mediterranean on the west, the valley of the Jordan and of the Dead Sea on the east, and Arabia Petræa on the south. Pop. (1900) 34,500.

Gazelle, a small antelope of the genus *Gazella,* or some related genus, exemplified by the «ariel» or «dorcas» of the Saharan and Syrian deserts, famous in poetic literature. The group contains some 25 species scattered throughout all Africa and southern Asia; and as a whole is characterized by small or moderate size, a sheep-like dentition, sandy coloration with white belly, and the usual presence of dark and light stripes on the face and flanks. The horns are of fair length, ringed, lyrate and usually present in both sexes. The gazelle (*G. dorcas*), stands about 24 inches tall at the shoulders, and has horns about 13 inches long. It is of delicate build, and extreme swiftness, leaping high as it runs, so that at full speed it seems to skim the ground like a flying bird. Its color is a light fawn upon the back, deepening into dark-brown in a wide band which edges the flanks and separates the yellow-brown of the upper portions of the body from the pure white of the abdomen. The face is marked with two stripes of contrasting colors, and the hindquarters are white. The eye of any gazelle is large, soft, and lustrous, and has been long employed by eastern poets as the most flattering comparison to that of a woman. Gazelles feed generally at dawn and at evening, and approach water only once in 24 hours. They are hunted in various ways, and their flesh is excellent. This species is becoming rare, but may still be found throughout the Sahara, and in the stony deserts of Syria. Many local names have been applied to it in books of travel and reference, most of which belong elsewhere. Such are the «korin» or «corinne» of Senegal (*G. rufifrons*); the West African «mohr» (*G. mohr*), the largest (32 inches high) and tallest of the race; the «aoul» (*G. sœmmerringi*) of Abyssinia and Somaliland, the «dama» (*G. dama*) of the Sudan, and others formerly confused with *G. dorcas.* Still other species range the plains of Central and South Africa, where some, as the springbok (q.v.), formerly assembled in vast herds, as described under ANTELOPE. Another group is formed by three similar Asiatic gazelles, — one common in Persia (*G. gutturosa*), and the others eastward, where the «goa» dwells on the high Tibetan plateau. Lastly in the Indian gazelle (*G. bennetti*), the «ravine-deer» of Indian sportsmen, we have a species with almost straight horns, which is about 26 inches tall, light chestnut in color with a blackish tail, and dwells in small bands in the dry plains along both sides of the Indus.

Gazette. *Gazzetta* was the name of a small coin once in use at Venice, and also of a kind of primitive newspaper, published there and sold for that sum. *Gazzetta,* Spanish *Gazeta,* French *Gazette,* are still used for a newspaper, but the term in England is confined to that paper of news published by authority of the government. The first 'Gazette' in England was published at Oxford 7 Nov. 1665. From that period the 'Gazette' has appeared regularly twice a week, and besides the notifications published by court and government, contains those required by law in private transactions. See NEWSPAPERS.

Gazetteer, a geographical dictionary. The first work of this kind with which we are acquainted is that of Stephen of Byzantium, who lived in the beginning of the 6th century. We have only an abridgment of it. The first modern work of the kind is the 'Dictionarium Historico-Geographicum' (Geneva 1565), by Charles Stephens, with additions by N. Lloyd (Oxford 1670, and London 1686). The works of Ferrari ('Lexicon Geographicum,' 1627) and Baudrand ('Geographia Ordine Literarum Disposita,' 1682) are full of the strangest errors. Those of Maty (1701), Thomas Corneille (1708), and Savonarola (1713) were based on the former, with additions and corrections. The 'Dictionnaire Géographique, Historique et Critique,' of La Martinière (1726), superseded all that had gone before it, though it retained many errors. The 'Geographisch-Statistisches Handwörterbuch' of the eminent German geographer Hassel (1817) was the result of laborious and judicious investigations. The 'Universal Gazetteer,' by Cruttwell (London 1808) and the 'Edinburgh Gazetteer'

(1817-22), once the principal works of the kind in English, were in course of years superseded by several others, among them Macculloch's 'Geographical Dictionary,' Blackie's 'Imperial Gazetteer' (Glasgow 1850), Lippincott's 'Pronouncing Gazetteer of the World' (Philadelphia 1855, with new editions and revisions), and Longmans' 'Gazetteer of the World.' The most valuable among European gazetteers further include the French 'Dictionnaire Géographique Universel,' Saint-Martin's 'Nouveau Dictionnaire de Géographie Universelle,' and Ritter's 'Geographisch-Statistisches Lexikon.' There are also gazetteers confined to individual States of the Union, and others to particular countries of the world.

Gears. See WHEEL GEARING.

Geary, John White, American military officer and politician: b. Mount Pleasant, Westmoreland County, Pa., 30 Dec. 1819; d. Harrisburg, Pa., 8 Feb. 1873. He was a lieutenant-colonel in the Mexican war; went to California and was appointed postmaster at San Francisco in 1849, being the first to hold that position in the city. In 1850 he was elected the first mayor of San Francisco, and in 1856 was made territorial governor of Kansas. When the Civil War broke out he enlisted in the Union army and became brigadier-general of volunteers 25 April 1862. He was in the battle of Cedar Mountain 9 Aug. 1862, and commanded a division at Chancellorsville, Gettysburg and Lookout Mountain. He also participated in Sherman's march to the sea. He was governor of Pennsylvania from 1867 till shortly before his death.

Gebhardt, Eduard von, ed'oo-ärd fōn gāb'-härt, German painter: b. St. Johannes, Esthonia, 13 June 1838. He studied at the St. Petersburg Academy in 1854–7, and later with Wilhelm Sohn at Düsseldorf, where he established his studio and attracted much attention by his religious works, in which he treated biblical scenes after the manner of the Dutch and Germans of the 15th and 16th centuries, imitating their introduction of costumes and other features contemporary to them. He also painted many scenes from the period of the Reformation. In 1873 he was appointed professor in the Düsseldorf Academy. His subjects include: 'Christ's Entry into Jerusalem'; 'The Rich Man and the Beggar Lazarus'; 'The Last Supper,' his chief work (National Gallery, Berlin); 'The Ascension,' one of his best canvases; 'Religious Conversation'; and 'The Reformer at Work.'

Geckos, gek'ōz, the small lizards of the family *Geckonidæ*, distinguished from other lizards by structural peculiarities which indicate that the group is a very ancient and distinct one. Externally their robust forms, short heads and thick, but fragile tails; the skin, in most soft and pebbled with minute bony concretions (osteoderms); the lack of eyelids, the ball of the eye being studded by a transparent watch-glass-like scale; and adhesive feet are so highly characteristic that a gecko is usually recognizable at a glance. The group consists of about 50 genera, comprising some 270 species, and they are scattered all over the warmer part of the globe, occurring even in New Zealand and many oceanic islands. Most of the species are small, the largest not much exceeding a foot. They dwell mainly in the woods, and among rocks, hiding by day, or basking quietly in the sun, and becoming active at night. They are carnivorous, the smaller eating insects, and the larger bigger insects and whatever else they can catch. They are well fitted for scrambling about tree-trunks and cliffs, as is seen in the agility of the common "tarentola," "osga" and other geckos of southern Europe, and the almost domestic "cheecha" (*Hemidactylus*) of Ceylon and India, which are numerous both outside and inside of farm and village houses, snapping up flies. They will climb a smooth wall or even a window pane without difficulty, and even run back downward along the smooth whitewashed ceiling. This is possible for them by the fact that the soles of the cushions of the toes are furnished with transverse lamellæ beset with tiny hair-like excrescences, between each two of which a vacuum is formed by the pressure of the foot on every step. Upon the differences in the arrangement of the pads and lamellæ are based generic distinctions. In addition to this facility of movement, one species (*Ptychozoön homalocephalum*), the flying or fringed gecko of the Malayan region, has a lateral parachute-like membrane assisting it to make long leaps from tree to tree.

Geckos are entirely harmless and could not inflict a painful bite if they tried; yet the peasants of Spain and Italy fear as poisonous even those which they see daily in their houses, and the Egyptians accuse them of leprosy. When encouraged they become tame and friendly and show considerable intelligence. Their voices produce a feeble clicking sound, often repeated, from which comes the term "Gecko" and such local names as "toco-toco" and the like. They reproduce by hiding among rotten wood two or three globular hard-shelled eggs, from which the young hatch, and are ready at once to begin to care for themselves. Consult Gadow, 'Amphibia and Reptiles' (1901); Gosse, 'A Naturalist's Sojourn in Jamaica' (London 1851).

Ged, William, Scottish goldsmith, inventor of stereotyping, b. Edinburgh 1690; d. there 19 Oct. 1749. In 1725 he took out a patent for his method of stereotyping, which was for long the only one in use. He met with such opposition in Edinburgh that he went to London, but there also failed to get his invention adopted. In 1731 he obtained a contract to print Bibles and prayer-books for the University of Cambridge, but only two prayer-books had been executed when the lease was surrendered. He stereotyped an edition of Sallust in 1744. Consult 'Memoir,' by Nichols (1781).

Geddes, gĕd'ĕs, **James,** American scholar: b. Boston, Mass., 29 July 1858. He was graduated from Harvard in 1880, was instructor in Romance languages at Boston University in 1887–90, assistant professor in 1890–92, and in 1892 was appointed professor. His writings include various monographs and articles for periodicals, and student's editions of Spanish and Italian classics.

Geddes, James Lorraine, American soldier: b. Edinburgh, Scotland, 1827; d. 1887. After residence in Canada, he studied in the British military academy of Calcutta, India, distinguished himself in the Punjab, and settled at Vinton, Iowa, in 1857. In the Civil War he served from 1861 to 1865, and attained the brevet rank of brigadier-general of volunteers. He

wrote: 'The Stars and Stripes,' 'The Soldier's Battle Prayer,' and other war verse.

Geefs, Gillaume, gē-yōm gāfs, Belgian sculptor: b. Antwerp 10 Sept. 1806; d. Brussels 24 Jan. 1883. He became professor at the Academy of Antwerp in 1834. Among his most important works are the monument to the victims of the Revolution of 1830 at Brussels; a statue of Rubens in front of Antwerp Cathedral; statues of King Leopold, etc.

Geefs, Joseph, Belgian sculptor: b. Anwerp 25 Dec. 1808; d. there 10 Oct. 1885. He was a brother of Gillaume Geefs (q.v.). In 1841 he was appointed professor of sculpture in the Antwerp Academy, and in 1846 became a member of the Belgian Academy. Among his principal works are: A statue of Vesalius, at Brussels; one of Martens, the first Belgian printer, at Aelst; an equestrian statue of Leopold I., at Antwerp; and 'The Fallen Angel,' in the Brussels Palace of Fine Arts.

Geelong, gē-lông', Australia, a city of Victoria, on Corio Bay, 45 miles south of Melbourne. The gold discoveries in 1851 added to its prosperity. Limestone and a kind of marble are found in the neighborhood. The industries are the manufacture of woolen cloths and paper, meat preserving, tanning, rope making, fishing, etc. The city is lighted with gas, and has two parks, botanical garden, government buildings, a town hall, hospital, chamber of commerce, mechanics' institute, etc. Corio Bay is a favorite bathing resort. Pop., including suburbs (1901), 23,440.

Geelvink (gāl'vĭnk) **Bay,** an arm of the Pacific in New Guinea. Its entrance, about 155 miles wide, is protected by several islands.

Geertz, gärts, **Julius,** German painter: b. Hamburg 21 April 1837. He was a pupil of Günther and Martin Gensler at Hamburg, of Descoudres at Carlsruhe, and of Jordan at Düsseldorf, located his studio at Düsseldorf, and established his reputation by his skilful genre scenes, of which the 'Criminal after Condemnation' was the first to win prominent notice. His works, characterized in general by excellence of design and color, fidelity of interpretation, and a capital sense of humor, include: 'The Fly-catcher'; 'Die Wacht am Rhein'; 'A Prisoner of War'; 'The Village Hero'; 'Alms.' During a visit to the United States he painted portraits of Oswald Ottendorfer, Carl Schurz, and other German-Americans.

Geese, a large group of water-birds allied to the ducks and swans, and forming with them the family *Anatidæ*. It is not possible to separate geese and ducks into two well-defined groups. Generally speaking, however, geese are distinguished by their larger size; short, heavy bill, with reduced lamellæ; longer legs, placed nearer the centre of the body; and the absence of enlargements of the bronchial tubes. Some thirty species of true geese exist, and about a dozen others are usually known by that name. Males are called "ganders," and young birds "goslings." The most typical geese are those of the genus *Anser*, represented in Europe by the gray lag (*A. cinereus*), bean-goose (*A. segetum*) and white-fronted goose (*A. albifrons*). A variety of the last occurs also in North America. The gray-lag goose is the original of the domestic races of geese. In its wild state it ranges over nearly the whole of Europe and northern Asia, and was formerly an abundant breeder on the British Isles.

The best known wild geese in America are the Canada goose (*Branta canadensis*), the brant (*B. bernicla*) and the snow-goose (*Chen hyperboreus*). The former presents several varieties differing mainly in size, the Hutchin's and cackling goose of the West being not larger than big ducks. One form or another occurs all across the continent, breeding mainly north of the United States, migrating southward in the autumn, and wintering on the coasts and inland waters, where they are regularly hunted by sportsmen. In early spring the northward flight of these geese in their customary V-shaped rank is heralded as an indication that winter is over. The brent goose or brant is a smaller darker bird, breeding far northward and occurring along our coasts often in immense numbers during the winter, and also on the coasts of Europe, being everywhere a salt-water bird. The black brant of our western coast, and the bernacle goose (q.v.) of the north of Europe, are allied species. Several species of snow-geese or laughing geese, are found in America, most plentifully in the interior. Most of them are pure white in the adult state, more or less gray during the first year; but the blue goose (*Chen cærulescens*) is always bluish gray, with the head white in the adult.

In Patagonia and the adjacent islands are several peculiar geese in which the sexes differ totally in coloration, the males being white and the females brown; some of them are strictly upland birds. The largest known goose is the Chinese swan-goose (*Cygnopsis cygnoides*), which is supposed to be the parent stock of the domestic geese of some eastern countries. The peculiar Cape Barren goose of Australia (*Cereopsis novæ-hollandiæ*), an upland goose which has lost the power of flight, has the webbing of the toes greatly reduced and the bill very short and rounded. Another curious species is the spur-winged goose of Africa (*Plectropterus rueppelli*) which possesses hornlike weapons on the bend of the wing. This is a beautiful bird bred in captivity by fanciers for ornamental service.

Domestic Geese.— The breeding of geese is followed on a large scale in some countries and was formerly extensively carried on in parts of England, where the flocks were regularly tended by a gooseherd and driven daily to pasture and water. Geese are valuable not only for their flesh and eggs, but for the plumage, and where kept for the latter purpose are plucked four or five times a year. The feathers are used chiefly for stuffing pillows, etc.; but as a result of public sentiment against the use of the plumage of wild birds in millinery, the manufacture of artificial plumes and feather-ornaments for hats is becoming an important industry, and goose-feathers form the basis of most of these fabrications. Geese are often specially fattened for the table. The liver of a fat goose is often larger than all the other viscera. The celebrated *pâtés de foie gras* of Strasburg are made of goose-livers, which are brought to a state of abnormal enlargement by keeping the birds in an apartment with a high temperature and cramming them with food. The oily fat and preserved breasts of geese are German delicacies. Six

standard varieties of domestic geese are kept in the United States, for practical purposes, as follows:

Gray Toulouse.— Derived from the neighborhood of Toulouse, France; compact in form; gray, with brown wing-quills, hazel eyes, and bills and feet deep orange; full weight, 20 pounds. They are late in maturing, and hence are often called Christmas geese; their flesh is not of the best, but they are good egg-layers. They are bred largely by farmers.

White Embden.— Large, tall, snow-white geese derived from Westphalia, weighing 18 to 20 pounds when adult; eyes blue, bills flesh-color; feet deep orange. They are highly regarded by farmers as practical birds.

Gray African.— Tall, with long necks and large heads, a large knob on the base of the bill and a heavy dewlap; general color gray, darkest on the back; eyes hazel; bill black; feet dark orange; weight, 18 to 20 pounds. These are by many raisers considered the most profitable of all geese to keep. They grow the heaviest in the shortest space of time, are ready for market in 10 weeks, and as compared with other geese give the most satisfactory returns for the least labor and time spent in growing them. They are first-class layers and their flesh is fine and nicely flavored.

Chinese Geese.— Small graceful geese in two varieties, brown and white, weighing as adults 12 to 14 pounds. In colors and the shape of the head and knobbed bill they resemble the African breed; the white variety is pure white throughout, with the bill orange instead of black. They are the most prolific layers of all the breeds, averaging 50 to 60 eggs a year; and are otherwise commendable, especially for the table.

Wild Geese.— Descendants of the American wild goose; weight 14 to 16 pounds. They are very generally bred throughout the country, and exhibit many good qualities.

Consult Weir, 'The Poultry Book' (New York, 1903).

Geezeh. See Gizeh.

Geffrard, zhĕ-frär, **Fabre,** Haitian president: b. L'Anse-à-Beau 19 Sept. 1806; d. Kingston, Jamaica 11 Feb. 1879. In 1843 he joined Gen. Hérard's insurrection against President Boyer, and as commander of Hérard's advance guard, annihilated Boyer's force at Numéro Deux. In the wars with Santo Domingo (1849, 1856) he fought with distinction, later led a successful insurrection against President Soulouque, and was president from 1859–67, when a conspiracy of Salnave, an army officer, obliged him to escape to Jamaica.

Gefle, yāf'lā, Sweden, a seaport town and capital of Gefleborg, and at the mouth of a river of same name in the Gulf of Bothnia. It stands on both sides of the river and two islands formed by it, consists of spacious and well-paved streets, and houses partly of wood and partly of stone; and has an old castle, ship-building yards, and an excellent harbor. Pop. (1900) 29,522.

The district of Gefleborg has an area of 7,614 square miles; a coast deeply indented by bays, and an interior partly mountainous and covered with pine forests, and containing a large number of lakes, which, with the streams between them, form a kind of continuous network. The rearing of cattle is the chief employment. The most valuable mineral is iron. Pop. (1900) 228,862.

Gefleborg. See Gefle.

Gehenna, gē-hĕn'ạ. See Hell.

Gehennam, gē-hĕn'ạm. See Tophet.

Gehlenite, gā'lĕn-īt (named by Fuchs after his colleague Gehlen), a grayish-green or brown tetragonal mineral; hardness 5.5 to 6; specific gravity 2.9 to 3.1; lustre resinous or vitreous; fracture uneven to splintery. It is composed of a silicate of calcium and aluminum, $Ca_3Al_2Si_4O_{10}$. This mineral has feeble double refraction. It is found in the Tyrol and in Banat, and occasionally occurs among the scoriæ of furnaces.

Geijer, gī'ĕr, **Eric Gustaf,** Swedish historian: b. Ransäter, Wermland, 12 Jan. 1783; d. Stockholm 23 April 1847. Beginning to lecture at Upsala in 1810, he was elected in 1815 assistant professor, and in 1817 professor of history at Upsala. Geijer exercised a marked influence on the poetic no less than on the historical literature of Sweden. Great as is the value of Geijer's historical works, he unfortunately did not complete any one of the vast undertakings which he planned. Thus, of the 'Svea Rikes Häfder,' or Records of Sweden (1825), which were to have embraced the history of his native country from mythical ages to the present time, he finished only the introductory volume. This, however, is a thoroughly good critical inquiry into the sources of legendary Swedish history. His next great work, 'Svenska Folkets Historia' (1832–6), was not carried beyond the death of Queen Christina. Of his other historical and political works may be mentioned 'The Condition of Sweden from the Death of Charles XII. to the Accession of Gustavus III.' (1838), and 'Feudalism and Republicanism' (1844). During the last 10 years of his life Geijer took an active part in politics; but, although his political writings possess great merit, the very versatility of his powers diverted him from applying them methodically to the complete elaboration of any one special subject. He was also known to his countrymen as a musician and composer of no mean order. His collected works were published by his son, with a biographical sketch (13 vols. 1849–56).

Geikie, gē'kĭ, Sir **Archibald,** Scottish geologist and scientific writer: b. Edinburgh 28 Dec. 1835. He entered the geological survey in 1855 and has since had a brilliant career of discovery and experiment, and held many important honorary positions. Among his publications are: 'The Story of a Boulder' (1858); 'Elementary Lessons in Physical Geography' (4th ed. 1884); 'Scenery of Scotland Viewed in Connection with its Physical Geology' (2d ed. 1887); 'Outlines of Field Geology' (4th ed. 1881); and 'Text-Book of Geology' (3d ed. 1893); 'The Ancient Volcanoes of Britain' (1897).

Geikie, James, Scottish geologist, brother of Archibald Geikie (q.v.): b. Edinburgh 23 Aug. 1839. He was educated at Edinburgh University in which he held the chair of geology in 1882. He is the author of: 'The Great Ice Age' (1874); 'Prehistoric Europe' (1882); 'Outlines of Geology' (1884); 'Fragments of Earth Lore' (1892); 'Earth Sculpture' (1898).

Geikie, John Cunningham, English Anglican clergyman: b. Edinburgh 26 Oct. 1824. He was educated at the University of Edinburgh, was pastor of Presbyterian churches in Halifax and Toronto, was ordained priest of the Established Church in 1876, and was successively curate of St. Peter's, Dulwich, 1876–9; rector of Christ's Church, Neuilly, Paris, 1879–81; vicar of St. Mary's, Barnstaple, 1883–5; and vicar of St. Martin-at-Palace, Norwich, in 1885–90. His publications include: 'The Life and Words of Christ' (1876); 'Old Testament Characters' (1880); 'The English Reformation' (1884); 'Landmarks of Old Testament History' (1895); 'A New Short Life of Christ' (1898); 'The Vicar and His Friends' (1901).

Geisha, gā'sha, a Chino-Japanese word, meaning "one with pleasing accomplishments," applied to Japanese singing and dancing girls who furnish entertainment in tea-houses and at social gatherings.

Geissler, Heinrich, hīn'rĭH gīs'lĕr, German mechanician: b. Igelshieb, Germany, 26 May 1814; d. Bonn, Prussia, 24 Jan. 1879. He became known as a maker of physical and chemical apparatus and principally as the inventor of Geissler's tubes (q.v.), an apparatus for producing light by an electric discharge in vacuo.

Geissler's Tubes, tubes made of very hard glass, and containing highly rarified gases. Each end of the tube has a platinum wire sealed into it to serve as electrodes. When a discharge of electricity is caused to take place in these tubes by connecting the electrodes to the terminals of a Ruhmkorff's coil or a Holtz's machine, very brilliant effects may be produced. The invention was named after Heinrich Geissler (q.v.).

Gela, jē'la, Sicily, a city of ancient Greece, situated on the island between Agrigentum and Camarina; founded in 690 B.C. by the Cretans and Rhodians. The colony was remarkably prosperous, and in 528 B.C. sent out a portion of its inhabitants, who founded Agrigentum. In 280 Phintias, the tyrant of Agrigentum, utterly destroyed Gela.

Gelada, gĕl'a̤-da̤, a kind of baboon (q.v.).

Gelasius (jē-lā'sĭ-ŭs) **I., Saint,** Pope: d. 19 Nov. 496. He succeeded Felix III. on 1 March 492. At the Council of Rome in 496 he distinguished the canonical books from the apocryphal of Scripture. He also regulated the canon of the Mass. He was succeeded by Anastasius II.

Gelasius II. (Giovanni di Gaeta, jō-vän'nē dē gä-ā'tä), Pope: d. Cluny, France, 29 Jan. 1119. He was cardinal and chancellor under Urban II. and Paschal II., and on the death of the latter was chosen pope by the party hostile to the Emperor Henry V. The imperial party at Rome under the Frangipani seized his person, but were forced to set him free by the menacing attitude of the mob. The new pope fled before the advancing imperial troops to Gaeta, where he first received his consecration, and whence he excommunicated Henry V. and Gregory VIII., the antipope Henry had set up. Soon after he was able to return to Rome, but ere long had to betake himself for protection to France, where he died in the monastery of Cluny.

Gelatine, jĕl'a̤-tĕn, or **Gelatin** (Latin, *gelatus*, "frozen," so named from the tendency which the substance has to congeal and become to a certain extent solid), in chemistry $C_{75}H_{124}N_{24}O_{29}$ (?). Animal glutin, obtained by treating bones with dilute hydrochloric acid, which dissolves the mineral constituents of the bone, consisting of phosphates and carbonates of calcium, magnesium, etc., and leaves the bone cartilage. This, when boiled for a long time with water, dissolves, and forms gelatine, which can be purified by dissolving in hot water and precipitating by alcohol. A pure variety is obtained from the swimming bladder of the sturgeon. Impure gelatine glue is prepared by boiling down pieces of hide, horn, hoof, cartilage, etc., with water under pressure. Pure gelatine is amorphous, transparent in thin plates, of a yellowish-white color; it has neither taste nor smell, and is neutral to vegetable colors; it is insoluble in alcohol and in ether. In contact with cold water it swells up, and is soluble in hot water. It is not precipitated by acids, except by tannic acid, which gives a flaky precipitate insoluble in water, alcohol, and ether. The aqueous solution of gelatine turns the plane of polarization to the left. Gelatine subjected to dry distillation yields methylamine, cyanide of ammonium, pyrrhol, etc.; by oxidation with sulphuric acid and manganese dioxide, or with chromic acid mixture, it yields hydrocyanic acid, acids of the fatty series, benzoic aldehyde and benzoic acid, etc. Gelatine boiled with caustic potash yields glycocine and leucine. Gelatine contains about 50 per cent. of carbon, 6.6 of hydrogen, and 18.4 of nitrogen. Moist gelatine exposed to the air rapidly putrefies, the liquid becoming first acid, but afterward it gives off ammonia. Gelatine gives no precipitate with lead acetate, alum, or ferrocyanide of potassium. A mixture of gelatine with potassium dichromate becomes, when exposed to the action of light, insoluble in water. The nutritious value of gelatine has been much overestimated. Isinglass is prepared from the form derived from the sturgeon's bladder; and gelatine is also made use of in photography (q.v.).

Gelatine Process. See PHOTOGRAPHY AND PHOTO-ENGRAVING.

Gelderland, Hĕl'dĕr-länt, or **Guelderland,** a province of Netherlands, with the Zuyder Zee on its northern boundary. Area, 1,965 square miles. The surface is level, the soil of the north sandy, the southern part low, marshy, but when cultivated, fertile. The principal rivers are the Rhine and the Meuse. The capital is Arnhem (q.v.). (For history see NETHERLANDS.) Pop. 567,489.

Gelée, zhė-lā, **Claude.** See CLAUDE LORRAINE.

Gelert, Johannes Sophus, American sculptor: b. Schleswig, Denmark, 10 Dec. 1852. He studied in the Royal Academy of Fine Arts at Copenhagen in 1870–5, removed to the United States in 1887, received a gold medal and honorable mention at the World's Columbian Exposition (1893), a gold medal at the Nashville Centennial Exposition (1897), and honorable mention and a gold medal at the Paris Exposition of 1900. His works include the monument to the policemen killed by the Chicago anarchists,

Haymarket Square, Chicago; statues of Beethoven and Andersen in Lincoln Park, Chicago; a statue of Grant at Galena, Ill.

Gellius, jĕl'ĭ-ŭs, **Aulus,** Roman author: b. possibly about 130 A.D. He studied rhetoric at Rome and philosophy at Athens, and practised as a lawyer at Rome. He is the author of 'Noctes Atticæ,' full of interesting observations and quotations, from the best Latin and Greek authors, relating to language, literature, history, and antiquities. This work was partly compiled in the winter nights during his residence at Athens. It is now of great value, as the authors from which he drew his materials are in a great measure lost. Among the best editions is that of Hertz (1883–5).

Gelon, jē'lŏn, tyrant of Gela and afterward of Syracuse: d. about 478 B.C. He was a scion of a noble family of the former city, and succeeded its tyrant, Hippocrates, in 491 B.C. Six years later he made himself master of Syracuse also, which then became the seat of his government, and to which he transferred the majority of the inhabitants of Gela. Gelon refused to aid the Greeks against Xerxes, as they declined to comply with his demand that he should be appointed commander-in-chief. The clemency and wisdom of Gelon rendered him so generally beloved that when he appeared unarmed in an assembly of the people, and declared himself ready to resign his power, he was unanimously hailed as the deliverer and sovereign of Syracuse.

Gelose, jē'lōs, a pectic substance containing carbon, 42.77; hydrogen, 5.775; oxygen, 51.455, prepared by Payen from a commercial article entitled Chinese moss, which consists of long white threads made up into bundles, and from various seaweeds. It is used for food, and is said to be the juice of a lichen growing on trees in the south of China and in the Philippine Islands. The moss, when boiled in water, dissolves, with the exception of 2 or 3 per cent of nitrogenized corpuscles and traces of other matter, and on cooling forms a transparent colorless jelly, which when dried constitutes gelose. It is distinguished from other bodies by certain characteristic reactions.

Gelsemium, jĕl-sē'mĭ-ŭm, yellow jasmine, the dried rhizome and roots of *Gelsemium sempervirens;* a southern climbing-shrub with a large woody underground stem and dark-green leaves, and bright, yellow sweet-scented flowers. It grows from Virginia southward in woods, and mounts to the top of tall trees. The active constituents contained in the underground stem are two alkaloids, gelsemine and gelseminine, the latter of which is the more potent. Gelsemium is an acute poison, acting both on the sensory and motor end-organs, causing anæsthesia and motor weakness. The early symptoms of large doses are loss of power in the muscles of the eye, causing drooping of the lids, dizziness, drowsiness, and disturbance of vision. In poisonous doses there is marked diminution in the force of the pulse and respiration, with difficulty of speech, coldness of the body surface and general loss of skin sensations. Death results from asphyxiation. Its most important medicinal use is in neuralgias, in sick-headache, and as a general nerve tonic.

Gemini, jĕm'ĭ-nī, the Twins (♊), the third sign of the zodiac. The sun enters this sign on or about 21 May, and leaves it on or about 21 June. The name belongs also to a northern constellation, of which the two chief stars are Castor and Pollux. They are very nearly equal in brilliancy, which fact probably suggested the name. Pollux is slightly the brighter. It is a quadruple star. Castor is one of the finest of the double stars. See ASTRONOMY.

Gemistus, jĕ-mĭs'tŭs, **Georgius.** See PLETHO, GEORGIUS GEMISTUS.

Gemmi (gĕm'mē) **Die,** Switzerland, a narrow pass, nearly two miles long, which crosses the Alps at a height of 7,553 feet, and connects the Swiss cantons of Bern and Valois.

Gemmules, jĕm'ūlz. (1) In actual biology gemmules are aggregations of cells set apart in the body of sponges and polyzoans to serve as reproductive agents. This is one of the most primitive forms of reproduction. (2) In philosophical biology gemmules are hypothetical, self-reproducing particles in the reproductive protoplasm (a structure which is assumed) supposed to be bodily transmitted from parent to child, and to carry such qualities as are inherited by offspring.

Gems are precious stones of small size, such as may be used for setting in a ring, or for any similar purpose of ornament. Like everything else of great value, precious stones have been imitated, and the practice has been carried on from the earliest times. The art of glass-coloring was known to the ancient Egyptians, who produced excellent imitations of the most beautiful gems. Among the Romans in the time of Pliny the manufacture of false stones was far advanced as a branch of industry. There existed several treatises on the subject, and Pliny declared that it was a difficult task to distinguish the false gems from the true. The alchemists of the Middle Ages, according to Aquinas, successfully fabricated artificial jewels, and he instances the jacinth, sapphire, emerald, topaz, and ruby, as being skilfully counterfeited. About the middle of the 17th century, false stones were no longer manufactured according to methods differing for each stone, but according to a general formula much the same as that followed at the present day.

Artificial Gems.— The base of all modern artificial gems is a peculiar kind of glass of considerable hardness, brilliancy, and refractive power, called paste or strass, which is distinguished from ordinary glass by the presence of 50 per cent of oxide of lead among its constituents. When the strass is obtained very pure, it is melted and mixed with substances having a metallic base, generally oxides, which communicate to the mass the various desired colors. We give a few details showing how the principal gems may be imitated. The diamond being colorless, pure strass simply cut into brilliants and roses is used as a counterfeit. The ruby is imitated by mixing 1,000 parts of strass, 40 parts of glass of antimony, 1 part purple of Cassius (a preparation of gold and binoxide of tin), and 1 part in excess of gold. Sapphires are counterfeited by 1,000 parts strass, and 25 of oxide of cobalt. Topaz — the same formula as for ruby,

without the excess of gold, and heated for a less time. Emerald, 1,000 parts of strass, 8 oxide of copper, and 0.2 oxide of chromium. Amethyst, 1,000 parts strass, 25 oxide of cobalt, and a little oxide of manganese. Garnet, 1,000 parts strass, and a variable quantity of purple of Cassius according to the shade to be obtained. In all these preparations success mainly depends upon a thorough pulverization and mixture of the ingredients; the fusion should be long continued at a graduated and uniform maximum temperature, and the mixture be annealed in cooling. These imitations, which are made in immense quantities in large factories in France and elsewhere, are chiefly used in the manufacture of cheap jewelry.

Attempts have, however, been made with a fair measure of success to manufacture true gems by artificial processes. Of these processes we need only mention that introduced by the French chemists Frémy and Verneuil. They succeeded in manufacturing excellent rubies, very like the natural ones in shape and composition, by raising carefully to a red heat a mixture of alumina, barium fluoride, and a very small quantity of bichromate of potash. The rubies are found in a friable matrix. If a little cobalt oxide be present in the mixture, sapphires are obtained instead of rubies. Many experiments with a view to producing diamonds artificially have been made within recent years. From hydrocarbons, subjected to a very intense heat and enormous pressure, minute crystals have been obtained which are as hard as the natural diamond, scratching all other minerals, and not affecting polarized light. The process is, however, expensive, tedious, and dangerous, and the diamonds produced are as yet so small that it requires more than 1,000 of them to make a carat; only ½ carat has been produced, at an expense of $2,000; hence they represent nothing beyond a scientific value. A diamond exists in the meteorite from Cañon Diablo, Arizona, in the Kunz collection at the American Museum of Natural History, New York. This is the first diamond identified in a meteorite,— by Dr. G. A. Koenig, in 1891.

We come now to genuine precious stones which will be taken up in the order of their rarity and value:

Diamonds.— The diamond, although not the rarest nor the most valuable of precious stones, is often called "the king of gems." It consists of pure carbon, crystallized in what is known as the isometric system, almost always occurring in the form of a regular octahedron or some modification thereof. It is the hardest of all known substances, ranking as ten (10) in the scale of hardness. It possesses a higher refractive and dispersive power on light than any other gem, whence arise the extreme brilliancy, and the varied flashes of color, or "fire," that give it such beauty. Being carbon, it is combustible,— the only gem that is so,— burning to carbonic acid in oxygen, or even in air under suitable treatment; this property was discovered as long ago as 1691, by Cosmo I., of Tuscany, who ignited a diamond with a burning-glass. Its density is about 3.5. In color it varies much, from white or colorless to yellow, also brown, rarely green, blue, pink, rose-red, occasionally even black. Some diamonds phosphoresce upon friction, and glow strongly under the influence of violet and ultra-violet light, and the emanations from the new and singular element known as radium, or rather from its compounds. They are absolutely transparent to the X-rays, of Roentgen. All these properties serve as ready means for distinguishing real diamonds from the best imitations. The value of a diamond depends on several conditions, chiefly size, color, and brilliancy. As to size, they are rated by the carat (or karat). This was the name of certain small seeds, which when dried, are quite constant in weight, and were used in India for weighing gems. It has now become a fixed standard for this purpose, used among all civilized nations, as the "international carat." In 1871, the syndicate of jewelers, goldsmiths, and gem-dealers of Paris proposed to fix its value at .205 of a gram; and this was generally adopted in 1877, and accepted by the principal dealers of Paris, London, and Amsterdam,— the centres of the world's diamond trade. The English carat is equal to 3.1683 grains Troy (usually reckoned as 3.17 grains); so that there are 151½ carats in an English Troy ounce. The jewelers' carat is divided into halves, quarters, eighths, sixteenths, thirty-seconds and sixty-fourths. A quarter-carat is sometimes called a grain, though it is less than a true grain; and pearls are generally sold by the grain, in this sense. As to color, the highest value belongs to perfectly white stones, or to those of fine bright tints, whether rose, green, or blue. These last are very rare and command fancy prices. Yellow diamonds are much more frequent, but when of rich color, are valuable. Any half-way tints, however, such as yellowish whites, are far less desired. Some possess a delicate steely-blue tinge, sometimes a delicate opalescence, and are called "blue-white"; these are particularly the Brazilian stones from Bagagem, and are also notable for their phosphorescent property. Perfectly colorless and flawless diamonds are spoken of as of "first water," a term which varies, however, according to the class of goods carried by the dealer using it. Many of the African stones are what is called "Cape white," that is, faintly yellowish; these are indistinguishable from pure white ones by artificial light, but command much lower prices. The finest diamonds are not found in the Kimberley mines, but in the Orange River Colony and the Transvaal. Diamonds vary also in brilliancy, some having higher lustre than others. New South Wales yields small stones that are harder than usual, and at the same time exceedingly brilliant. All these natural qualities, together with perfection of cutting, enter into the estimate of values, and may cause very great differences. Of two diamonds of ten carats each, both flawless, one may be worth $600 and the other $12,000. Exceptional stones often bring special prices. Diamonds are occasionally found in many parts of the globe, but in only a few regions are they at all frequent or large, so as to be mined for. They were first obtained in India, then somewhat in Borneo, then in Brazil; more recently they are coming from New South Wales, and lately British Guiana is yielding a number. But all other sources are insignificant compared with the wonderful diamond mines of South Africa, which furnish 95 per cent of the world's supply,

and have yielded since their discovery some 30 years ago, more diamonds than all other sources together in all past time. A few are found in Siberia, and in California; also along a line east of the Blue Ridge from Virginia to Georgia, and along another line from Wisconsin to southern Ohio; but these are only occasional, and are more interesting than important. The diamond seems to have been unknown to the ancients, outside of India, until about the beginning of the Christian era. The words rendered "diamond" in the Bible, and in classical writings prior to that time, refer to other hard minerals.

Rubies and Sapphires.— The ruby and the sapphire, transparent varieties of corundum (q.v.), the first being carmine red, and the second bright blue. Other colors also occur, as yellow, green, and purple, called respectively, Oriental topaz, Oriental emerald, and Oriental amethyst. Corundum crystallizes in the hexagonal system, and consists of alumina nearly pure. In hardness it ranks next below the diamond, being rated as 9 on the scale. The finest rubies are found in Burma, in the Mogok Valley, northeast of Mandalay. They are also mined in Siam, of a darker red, and in Ceylon, of a lighter shade. The Burmese rubies have a peculiar tint, called "pigeon's blood." Sapphires come principally from Siam and Cashmere, the finest tints being known as the cornflower and the velvet blue. Rubies of large size are extremely rare, and when they are as much as three or four carats in weight, they are worth from five to ten times the price of diamonds of the same size. Sapphires are found in Montana at several points; the finest are mined at Yogo Gulch, in Fergus County; these are of fine rich blue. Other mines are at Rock Creek, Granite County, where there is a great variety of colors; also at Cottonwood Creek, and along the bars of the Missouri, not far from Helena. True rubies have been obtained lately in the Cowee Valley, Macon County, North Carolina, though not in large numbers.

Emeralds.— Emerald and beryl are in fact the same mineral, a silicate of alumina and glucina. Beryl varies from blue through light green to yellow, when it is called golden beryl, and forms a gem resembling topaz. If colored a deep rich green by a little oxide of chromium, it becomes the emerald, a stone which when flawless, ranks in value with the diamond. The chief source of fine emeralds has long been the mines at Muzo, near Bogota, in Colombia, where they occur in a limestone rock. The mine has been worked by Europeans for three centuries, and previously by the native peoples of South and Central America. The emeralds known to the ancients came principally from Upper Egypt, near the Red Sea. These mines have been long abandoned and unworked, but are now being somewhat reopened. In the United States some very fine and large crystals of emerald have been found in Alexander County, N. C., though they were hardly clear enough to cut into gems. Very fine pale-green beryls (aquamarines) have been obtained in Maine, North Carolina, and Colorado, and golden beryls in Maine, Connecticut, and Pennsylvania. All the beryls crystallize in the hexagonal system, as six-sided prisms.

Chrysoberyl, a very hard gem, is a compound of alumina and glucina. It is a rare mineral, of various shades of yellow, brown, and light green. One variety contains minute impurities distributed between the layers of the crystal, and these layers so arranged by what is called "twinning," that when the stone is cut across the layers, the light is reflected or condensed in a transverse bright line; such a gem is called chrysoberyl cat's-eye.

Topaz is a rather complicated silicate of alumina, occurring in rhombic prisms and possessing a hardness of 8. It is generally yellow, also pale blue, pale green, pale brown, and white (colorless). The favorite tint is a peculiar yellow known as sherry-color. The finest come from Brazil and from the Ural Mountains; but some very handsome ones have been found in Colorado and Utah.

Tourmaline, another complex silicate of alumina, occurring in prisms of six, nine, or twelve sides, is usually black, but also of transparent red, green, and other colors, often singularly mingled in the same crystal. These are found in Brazil and Siberia, and also of great elegance at Paris and Auburn, Maine, Haddam Neck, Conn., and especially in San Diego County, California.

Garnet is the name of a group of minerals closely related in form and properties, but presenting a number of varieties. They are all very complex alumino-silicates, in which various metallic oxides enter as ingredients. The principal gem varieties are: almandine, or precious garnet, containing considerable oxide of iron; its color is a deep rather purplish or brownish red; pyrope, or Bohemian garnet, containing much magnesia, is a fine dark crimson, almost ruby color. These two are the red garnets of jewelry; when cut *en cabochon*, that is, not faceted but rounded, they are called carbuncles. Manganese garnet, or spessartite, is sometimes of a very beautiful orange-brown color; elegant gems of this kind have been found at Amelia Court House, Virginia. Uvarovite, or chrome garnet, is a rare variety of brilliant green color, resembling emerald, but the crystals are very small. Another green garnet of somewhat different composition, and with very brilliant lustre, from the Ural mountains, is called demantoid, or Uralian emerald. Much fine garnet is found in the United States. North Carolina yields a beautiful variety that has been called rhodolite,— a brilliant light red garnet, between almandite and pyrope in composition; these are largely mined in the Cowee valley, in Macon County. New Mexico and Arizona yield fine pyropes, often miscalled Arizona rubies, and equaling those of any other known locality. They are found where centipedes have carried them out in making the galleries of their hills.

Among the finest gem collections in the United States are the Tiffany-Morgan collection and the Bement-Morgan collections at the American Museum of Natural History, New York; the Isaac Lea collection, at the United States National Museum, Washington, D. C.; the Tiffany collection, Field Columbian Museum, Chicago, Ill.; the Tiffany collection, Golden Gate Museum, San Francisco, Cal.; and the Kunz collection, at the State Museum, Albany, N. Y.

Bibliography.— De Fontanelle and Malepeyre, 'Glass, Artificial Stones, etc.'; King, 'Precious Stones and Metals'; Kunz, 'Gems and Precious Stones of North America'; Smith, 'Catalogue of the Gems of the British Museum'; Streeter, 'Precious Stones and Gems'; Tassin, 'Descriptive Catalogue of the Collections of Gems in the United States National Museum; Kunz, 'Report Dept. Mining Statistics United States Geological Survey.'

Geo. F. Kunz,
Gem Expert, Tiffany & Co., New York.

Gems, Engraving of, the glyptic art, or lithoglyptics; the art of representing designs on precious stones, either in raised work (cameos) or by figures cut into or below the surface (intaglios). The latter method was practised at a very early period, and probably had its origin with the Babylonians 4000 B.C., who worshipped the heavenly bodies, and were accustomed to wear figured talismans, which served as symbols of their influences. The Egyptians cut the hardest kind of stones for like purposes as early as 3000 B.C. The custom of wearing cut stones as seal-rings appears to have been general among the Greeks in the time of Solon. One of the earliest artists in this branch of whom mention is made is Mnesarchus, the father of the philosopher Pythagoras, consequently a contemporary of that Theodorus of Samos who engraved the ring of Polycrates, of which such wonderful stories are told by the ancients. These early works were probably intaglios; the artist made use of the lathe, the diamond-point, and by some it is thought, diamond-powder; but it is a question if the diamond was known before the 6th century A.D. Gem engraving flourished in Mycenæ, Smyrna, and ancient Greece, and from the time of Alexander the Great; but we can only judge of the works of Pyrgoteles, Apollonides, and Cronius from tradition, as there are no works of these masters extant. Pyrgoteles was distinguished for works in relief, and from his time the art may have risen gradually to that later degree of perfection of which we possess such rich specimens. The artists, some of whose names we learn from their works themselves, often took the masterpieces of sculpture for their subjects and models. Under the Roman emperors, in particular, this was very common. The chief early Greek engraver whose name is known from extant works of his is Dexamenos (late in the 5th century). The names of Dioscorides, Apollonides, Aulos, Hyllos, Cneius, Solon, remind us of the most perfect works in this branch of art, and many of the signed gems are forgeries or old gems with old names forged on them. But some of the greatest ancient works — the sardonyx of the Sainte Chapelle (Paris); the apotheosis of Augustus, at Vienna; the onyx at The Hague, representing the apotheosis of the Emperor Claudius; Achilles lamenting Patroclus; the head of Julius Cæsar — these, like the Brunswick vase and the Trivulcian and Neapolitan cups, bear no distinguished names. Pompey consecrated the dactyliotheca or collection of rings of Mithridates, as a votive offering in the Capitol, and Julius Cæsar, six tablets with six gems in the temple of Venus. At a later period the collections of Herodes Atticus, of Vespasian, etc., were celebrated; yet this general taste was not able to preserve the art from decline. Notwithstanding this decline, however, gems continued to be highly prized, even in the times of mediæval barbarism, and served to ornament the shrines of saints, and for royal badges, and ceremonial dresses, and thus passed safely through the ages of destruction and ignorance in which the finest statues were only valued as materials for mortar or for building, till ages arrived which could again appreciate their value. If we may judge from the remains which have come down to us, engraved gems seem to have been more common in the Byzantine empire than in the West.

The earliest gem-engraver of modern times is Vittore Pisanello, who lived in Florence about the year 1406. The first among the Germans was Daniel Engelhard, of Nuremberg, who died in 1512. The discovery of some fine specimens in Italy, particularly in Florence, and the display of gems by the Emperor Palæologus, at the Council of Florence in 1438, were perhaps the original cause of the taste of the Medici for engraved stones. The popes and that family were the first patrons of this art in modern times. A Florentine artist, generally called on account of his great skill, Giovanni delle Carniole ("of the Carnelians"), distinguished himself in this early modern period. There are few gems which can be ascribed to him with any confidence, except the famous carnelian in the Florentine Museum, with the portrait of Savonarola, bearing the inscription *Hieronymus Ferrariensis ordinis prædicatorum, propheta, vir et martyr.* This stone, which must have been engraved later than 1498, is given to Agincourt's work. Contemporaries and rivals of Giovanni were Nanni di Prospero delle Carniole, in Florence, whom Francesco Salviati directed in his works, and Domenico Compagnie (*dei camei*), a Milanese, whose portrait of Ludovico Sforza, called Moro, cut in a ruby, is still preserved in the Florentine Museum. After Bernardi (delle Carniole), Valerio Vicentino (under Leo X.) rendered himself famous as a gem-engraver. This art found patrons in all the Italian princes; the number of artists constantly increased, and the sphere of their work was extended. The names of these artists, however, are not generally known, because they are rarely put on the stones. Many gems, too, are still concealed in the cabinets of the wealthy or the treasuries of princes. Till these are accurately described, as those of the Ambrosian collection, it will be difficult to obtain a complete general view.

Subjects of antiquity were preferred by the artists of the 15th and 18th centuries, who treated them with such ability that it often requires the skill of the most accomplished connoisseur to distinguish them from genuine antiques. The dispute concerning the famous seal-ring of Michelangelo is well known. It is not improbable that this carnelian is the work of Pietro Maria da Pescia; as the figure of the fisherman in the exergue may indicate the artist who, with Michelino, belonged to the age of Leo X. In order to give the gems more completely the appearance of antiques, some artists engraved their names in Greek, but with so little knowledge of the language that they sometimes betrayed themselves by this artifice. To this time we must ascribe the gems with the name Pyrgoteles, which Fiorillo endeavors to prove were

the work of an Italian of Greek descent (Lascaris).

The art of engraving was also applied to glass and gold. The crystal box of Valerio Belli, the most skillful and industrious artist in this branch during the 16th century, deserves particular mention. It was intended by Clement VII. as a present to Francis I., when Catharine di Medici went to Marseilles in 1533. At present it is in Florence. The Milanese particularly distinguished themselves in gem-sculpture, as the wealth of the principal citizens of Milan enabled them to patronize this art. Jacopo da Trezza, the same artist who in 1564 executed for Philip II. the famous tabernacle of the Escurial, made the first attempts at engraving on the diamond in Milan. The greatest cameo work of modern times is the stone from the Florentine Museum, seven inches in breadth, on which Cosmo, Grand Duke of Tuscany, with his wife, Eleonore, and his seven children are represented. A Milanese, John Anthony de Rossi, who was a contemporary of the Saracchi family (about 1570), is the artist. The Saracchi were five brothers, and the crystal helmet of Albert of Bavaria is a proof of their skill.

Gem-engraving was popular in Germany in the 14th and 15th centuries, and in England, Natter, Pichler, and Marchant are considered the restorers of the art in later years in that country. The most eminent artist of more modern times is perhaps, Berini, a native of Rome, who, with Cervera and Giromelli at Rome, and Putinati, at Milan, produced very fine works. In our own times the demand for cameos and intaglios in the United States was greatest from 1870 to 1880. During that time more than 100 workmen found employment here,— many of them as portrait artists. Among these was Lebrethon, who had as a pupil our great sculptor Augustus Saint Gaudens; another, Zöllner, who engraved some fine and important cameos, took up brass working. Perhaps the greatest artist and the most active, L. Bonet, to-day has scarcely one sixth of his time occupied, whereas in the "Cameo age" he had the aid of nine assistants. In 1903 there appeared a slight revival of the wearing of antique and old-fashioned cameos of rather a pronounced form, and it is quite possible that the glyptic art is again on the way to favor.

A few of the gem collections are the famous Rev. C. W. King collection of antique gems, of the types used in his works; the Cesnola and other collections, at the Metropolitan Museum of Art; also a fine collection at the Boston Museum of Fine Arts; and the Maxwell Somerville collection, the types of his works, at the University of Pennsylvania, in Philadelphia, while the Walters collection, at Baltimore, Md., contains many of the finest gems in America.

Consult: Bellermann, 'Urim und Thummim, die ältesten Gemmen'; King, 'Antique Gems and Rings'; 'Handbook of Engraved Gems'; Middleton, 'The Engraved Gems of Classical Times'; Cicognara, 'Storia della Scultura'; Natter, 'Traité de la Méthode Antique de Graver en Pierre Fine, Comparée avec la Méthode Moderne'; Babelon, 'Le Cabinet des Antiques à la Bibliothèque Nationale.'

Geo. F. Kunz,
Gem Expert, Tiffany & Co., New York.

Gems, Mythology of. The ancients believed that each month of the year was under the influence of a precious stone, and in modern tin s this superstition has found many devotees. It is quite the prevailing custom in many fashionable European capitals to wear birth-month stones, in preference to other jewels. The following list has been current for many years:

January	Garnet	Constancy
February	Amethyst	Sincerity
March	Bloodstone	Courage
April	Diamond	Innocence
May	Emerald	Success in love
June	Agate	Health and long life
July	Cornelian	Content
August	Sardonyx	Conjugal felicity
September	Chrysolite	Antidote to madness
October	Opal	Hope
November	Topaz	Fidelity
December	Turquoise	Prosperity

The seven gems which are supposed to be undc the influence of the seven chief planets are these:

Saturn	Onyx
Jupiter	Cornelian
Mars	Diamond
Sun	Sapphire
Venus	Emerald
Mercury	Loadstone or lodestone
Moon	Crystal

The legend of the diamond tells how Diamond was the name of a beautiful youth of the island of Crete, who was one of the attendants of the infant Jupiter in his cradle. Diamond, not to be subject to "the ills that flesh is heir to," was transformed into the hardest and most brilliant substance in nature. The diamond among the ancients had the virtue of bestowing victory and fortitude. It calmed anger and strengthened wedded love; hence it was called the stone of reconciliation. The diamond, too, among the Greeks was a symbol of severe and inexorable justice and of the impassibility of fate. Hence the judges of Hades were described as having hearts of adamant.

Gemsbok, gĕmz'bŏk, a large South African antelope (*Oryx gazella*), gray in general hue, but along the back, on the hindquarters, and along the flanks the color is deep black. It has a short erect mane, a long sweeping black tail, and long sharp-pointed heavy horns, nearly straight from base to tip, and obscurely ringed throughout the lower half. It is asserted that the gemsbok never drinks water, the moisture which it needs being obtained from the succulent bulbous plants on which it feeds. It is one of a group of large antelopes, including the oryx, beisa, addax, etc., which are sometimes called the gemsboks, and the numbers of all which are rapidly diminishing toward extinction. See Antelope.

Gemünder, August, ow'goost gĕ'mün-dĕr, German-American violin-maker: b. Ingelfingen, Würtemberg, 1814; d. New York 1895. He studied the art of violin-making with Vuillaume at Paris; from 1846 to 1860 was at Springfield, Mass., where he won wide recognition for his violins; and in 1861 established his business in New York. His most important work was a copy of an Amati owned by Pablo Sarasate, the well-known Spanish violinist, who declared it equal to the original instrument.

Gemünder, George, German-American violin-maker: b. Germany 1816; d. New York

1899. He was a pupil of Baptiste Vuillaume of Paris, came to America in 1847, won the first prize with his violins at the Crystal Palace exhibition, London (1851), and in 1873 sent to the Vienna exhibition a copy of a Guarnerius declared by the jury of experts to be an original. It is said that his were the finest violins yet made in America. He published 'George Gemünder's Progress in Violin-Making' (1881). He was a brother of August Gemünder (q.v.).

Gendarmes, zhŏṅ-därm (Fr. «men-at-arms») were originally mounted lancers, armed at all points, and attended by five inferior soldiers, who were furnished by the holders of fiefs; these were replaced by Charles VII.'s *compagnies d'ordonnance,* which were dissolved in 1787, one company of gendarmerie being retained as the bodyguard of Louis XVI. Since the French Revolution, except for a short interval at the Restoration, the gendarmes have constituted a military police, which superseded the old *maréchaussée,* and comprises both cavalry and infantry; divided into legions and companies, and these latter into brigades, the organization of the force corresponds to the territorial divisions of the army. The men receive much higher pay than the rest of the army, of which, however, the corps is a part, its members being drafted from the line for this service. Germany also since 1808 has had its *gendarmen.* See POLICE.

Gender, in grammar, a difference in words to express distinction of sex. Strictly speaking there are but two genders, the *masculine* and *feminine;* words which did not belong to those classes were said to be *neutrius generis,* of neither gender; and from this phrase grammarians have, somewhat incorrectly, come to speak of this third class as being of «the neuter gender,» and thus recognize three genders. That the distinction of sex is the origin of grammatical gender cannot be reasonably disputed, and as a consequence the principle must have been originally restricted to living beings, and practically to those in which the distinction of sex was readily perceived. In the lesser animals it would have been more difficult to ascertain the sex, and generally unnecessary to denote it. But correctness and utility are not the only ruling principles of language; they are often sacrificed to the love of imagery and personification. In the infancy of language, when everything that was seen to produce an effect was conceived as actuated by a conscious will, every prominent object was endowed with one or other sex, the choice depending on the association of ideas. Strength, freedom, magnitude and violence are the marked attributes of the male; weakness, subjection, timidity, and gentleness of the female. In Hebrew there is no neuter; in Sanskrit, Greek, and Latin, the majority of the names applied to inanimate objects are either masculine or feminine; and in the languages derived from the Latin — Italian, French, Spanish, and Portuguese — a neuter gender is not recognized. In German, as in the classical tongues, the names of inanimate objects are sometimes masculine and feminine as well as neuter. English, getting rid of the spurious distinction that encumbered the Anglo-Saxon, attributes sex only to living beings. In the highly inflected languages there are certain terminations distinctive of the different genders, the most characteristic in the Greek being *os,* masc.; *ē,* fem.; and *on,* neuter; and the Latin *us, a, um.* In English the distinction of gender is often marked by the termination, the most common being the affix *ess* derived from the French; or by a different word. In most other languages the adjectives, articles, and participles are inflected for gender; in English the gender of a noun only affects the pronoun substituted for it. See GRAMMAR; LANGUAGE.

Gender, a Javanese musical instrument. It consists of a row of parallel metallic plates supported horizontally by two strings passed through the respective nodal lines of the plates. Underneath each plate is an upright bamboo, containing a column of air of such a height as to reciprocate the sound of the plate above.

Gendron, Auguste, ō-güst zhŏṅ-drôṅ, French painter: b. Paris 1818; d. there 12 July 1881. He was long a pupil of Delaroche, and several times visited Italy, where he painted his first important works. In addition to several canvases, including 'The Island of Cythera'; 'Tiberius at Capri'; 'Sunday in Florence — 15th Century'; he executed frescoes in the Louvre and the church of St. Gervais.

Genealog'ical Society, The New York, was incorporated in 1869, to procure and perpetuate whatever may relate to genealogy and biography. The 'New York Genealogical and Biographical Record,' now in its 28th volume, is published under its supervision. The society has published: 'Marriage from 1639 to 1801 in the Reformed Dutch Church, New York,' and other volumes. The society's building is at 23 West 44th Street.

Geneal'ogy (from the Greek *genos,* race, and *logos,* discourse), the systematical account of the origin, descent, and relations of families is an auxiliary of historical science. Genealogical knowledge becomes important in a personal or legal view, when family claims are to be established. Genealogy is founded on the idea of a lineage or family. Persons descended from a common father constitute a family. Under the idea of degree is denoted the nearness or remoteness of relationship in which one person stands with respect to another. A series of several persons, descended from a common progenitor, is called a line. A line is either direct or collateral. The direct line is divided into the ascending and descending. The ascendants are called, in general, *majores* (ancestors), and the descendants *posteri* (or posterity). The collateral lines comprehend the several lines which unite in a common progenitor. They are either equal or unequal, according as the number of the degrees in the lines is the same or different. The collateral relations on the father's side are termed *agnati,* on the mother's *cognati.* Children stand to each other in the relation either of the full blood or the half blood, according as they are descended from the same parents, or have only one parent in common.

For illustrating descent and relationship genealogical tables are constructed, the order of which depends on the end in view. In tables the object of which is to show all the individuals embraced in a family, it is usual to begin with the oldest progenitor, and to put all the persons of the male or female sex in descending, and then in collateral lines. Other tables exhibit the ancestors of a particular person in ascending

lines, both on the father's and mother's side. In this way 4, 8, 16, etc., ancestors, are exhibited. The tables showing the succession of rulers contain merely the descent of the persons who have reigned in succession, or who have claims to the government. In connection with them stand the tables of disputed succession, which represent several lines of a family, or several collateral families, in order to deduce their rights of succession from their degree of relationship. Synchronical tables consist of the genealogies of several families placed together, in order to compare, with facility, relationships, marriages, divisions of inheritance, etc. Historical genealogical tables differ from mere genealogical tables, as they attach to the descent the biographies also of the members. The common form of genealogical tables places the common stock at the head, and shows the degree of each descendant by lines.

The earliest genealogical tables are perpetuated in the Biblical family records of succeeding generations, in graven stone memorials of ancient Egypt, Assyria, Persia, India, and other oriental countries. Genealogical knowledge was most important in the Middle Ages, when the nobility was distinct from the other classes. Ancestors were unblushingly and impudently fabricated, the absence of criticism and the desire to flatter important people causing the introduction of the most absurd fables into genealogy, especially after the 14th century. Few families, no matter however distinguished and noble, can trace their ancestry beyond or even as far as the middle of the 11th century. The advance of civilization and particularly the institution of corporations and guilds in the towns of the principal European nations, afforded a wider scope for genealogy, and in the 12th and 13th centuries, family names began to be more common. The oldest trace of family names according to Gatterer is in 1062 when a Henricus de Sinna is mentioned in Schannat's "Buchonia Veteri." After history in general had attained a more systematic character, the Germans in particular treated genealogy on a more scientific basis. Ruxner's "Turnierbuch" (1527), and Reusner and Hennings' genealogical tables which appeared about the end of the 16th century, are among the earliest published works, but are not conceived in an historical spirit. Duchesne, Saint Marthe, Hozier, Chifflet, Lancelot le Blond, etc., in France, and Dugdale in England, initiated a clearer and more accurate treatment of the subject. The first genealogists in Germany to base the science on documentary evidence were Rittershusius of Altdorf (d. 1670) and Spencer of Wittenberg (d. 1730). The lines laid down by them were followed and carried to higher perfection by König, Von Imhof, and especially by Hübner in his "Genealogische Tabellen" (4 vols. 1725–33; new ed. 1737–66), to which Lentz added "Erläuterungen" (Elucidations, 1756), and Sophia, Queen of Denmark, "Supplement-Tafeln" (1822–24). Gatterer founded the scientific treatment of the subject in his "Abriss der Genealogie" (1788), and was followed by Pütter in his "Tabulæ Genealgicæ" (1798), by Koch in his "Tables Généalogiques" (1808), Voigtel (1810), Hopf (1861), Von Behr (1870), Cohn (1871), and Oertel (1871), all in Germany.

The principal genealogical MSS. sources in Great Britain are the public records, heraldic registers, and the parish registers of births, marriages, and deaths. The chief printed collections of genealogical information are the well-known Burke, Debrett, and other like publications of "Peerages, Baronages, Baronetages, and County Histories."

In the United States, genealogy was generally neglected until the latter part of the 19th century, when the organization of patriotic, State and colonial societies, like the Society of the Cincinnati, the Holland Society of New York, the Southern Society, etc., aroused an interest in genealogy. Genealogical societies have been organized in several States and the subject has received more or less attention. New York society folks in 1901–2 began to take up genealogy as a special fad or hobby and numbers of persons adopted the study of family trees as a regular employment. The principal publications in the United States on genealogy are 'The New England Historical and Genealogical Register;' 'The New York Genealogical and Biographical Record;' 'The Heraldic Journal;' the various biographical dictionaries and cyclopedias; the printed transactions and archives of State and city historical societies; county, State, city, and town histories.

Genee, zhē-nā, **Rudolf,** German author: b. Berlin, Prussia, 12 Dec. 1824. He abandoned wood engraving for journalism, and then became an instructor in literature at Berlin. As a reader and interpreter of Shakespeare he attained distinction; but his plays — 'The Prodigy' (1854); 'A New Timon'; 'In Front of the Cannon'; 'The Hermitess"; and adaptations from Sheridan — gave him wider fame. His works in criticism, treating of German poetry, the drama, and kindred themes, are highly esteemed. 'Marienburg' is a successful historical novel by him.

Genelli, Bonaventura, bō′′nä-vān-too'rä gā-nĕl'lē, German painter: b. Berlin 28 Sept. 1798; d. 13 Nov. 1868. He was the son of Janus Genelli (1771–1812), an engraver, with whom he early studied. His chief artistic training was obtained as a pupil of Johann Erdmann Hummel at Berlin and at Rome, where he resided in 1822–32, and executed numerous pencil and india-ink drawings which carried his name over much of the continent. From 1836 he was in Munich, often in poverty; for he received no public commissions and his work had as yet met its due recognition among but a few. In 1859 he was called by Grand-duke Charles Alexander to Weimar, where ample leisure was afforded him for his larger works in oil. He was a classicist like Carstens, whose methods he followed, and with him the chief thing was the rendering of line. Among his many works are the series of drawings for Dante's 'Divine Comedy,' and for Homer; other drawings in ink or water-colors, such as 'Hercules Playing the Lyre'; The 'Vision of Ezekiel,' and 'Æsop Telling His Fables,' and the pictures in oil: 'Abraham and the Angels'; 'The Battle of Lycurgus with Bacchus'; 'Bacchus among the Muses.' There is a biography of Genelli by Jordan (1869).

General, (1) A military rank and title. In the United States army, this rank, as distinguished from and superior to the major-general,

was created for Washington by Congress, 3 March 1799. He died shortly after, the office remained vacant, and in 1802 it was abolished. It was revived in 1866 for Grant, and on his accession to the Presidency in 1869, was conferred on William T. Sherman. On his retirement, 1 Nov. 1883, the rank was allowed to lapse. In June 1888 it was revived for Philip H. Sheridan; but on his death in August it again became extinct. The highest army officer has now the title of chief of staff. See GENERAL STAFF, UNITED STATES ARMY.

(2) The name given to the general superior of religious orders and congregations of men in the Roman Catholic Church. The general is usually elected in general chapter, and holds office for three years. In the Society of Jesus the general is elected for life. The generals of regular orders have been granted by popes special privileges, as power of absolution in reserved cases in relation to their subjects. Several modern congregations of women have general superiors, but their canonical position is quite different from that of the generals of the orders of men.

General Assembly. See ASSEMBLY, GENERAL; PRESBYTERIANS.

General Confession, in the Roman Catholic Church, is a sacramental confession of all sins committed by the penitent since baptism, or since of an age to know what sin is, so far as he can remember. Such general confession is made by persons who have made no previous confession, who have wilfully concealed a mortal sin; or been wanting in true and supernatural sorrow for the sins confessed in a previous confession; or are desirous of reviewing their past life for the purpose of interior advancement in the spiritual life.

General Court, the official name of the legislature of Massachusetts. The old English name of the meeting of a body of managers or members of any corporation is "court"; as court of aldermen, court of directors, etc. So the meeting of corporators of the old Massachusetts Company was called a court; then the primary assembly of freemen under its charter was called the General Court; and the name was retained after it became a representative body. There was the further reason that it really was the supreme judicial as well as legislative body. See MASSACHUSETTS.

General Education Board founded in New York City, February, 1902, chartered by Congress 12 Jan. 1903, has for its objects: (1) The promotion of education within the United States of America, without distinction of race, sex or creed; (2) the development of the public school system, especially in rural districts; (3) the development of the principle of self-help by promoting increased local taxation, local contributions or other means for educational purposes; (4) the increased establishment of training schools for teachers, especially those designed to educate instructors of industrial and manual training; (5) co-operation with the organizations interested in educational work, so as to simplify and make effective the general work of education, avoiding unnecessary duplication; (6) the collection of full information and statistics in respect to educational matters in the districts covered by the operation of the board, which shall be kept at a general office; (7) to furnish the public with information, suggestions and counsel, and for this purpose to act somewhat as a clearing-house for educational statistics and data to be collated by the board; (8) to educate public opinion in all matters pertaining to the general cause of education by publication of reports through the daily press and by other means.

The organization received the cordial support and gifts of several philanthropists, including John D. Rockefeller, Sr., and among the members of the board are John D. Rockefeller, Jr., Daniel Coit Gilman, Morris K. Jesup, William R. Harper, Frederick T. Gates, Walter H. Page, Albert Shaw, Hugh H. Hanna, E. Benjamin Andrews, Starr J. Murphy, secretary and executive officer for the states of the north and west; Wallace Buttrick, secretary and executive officer for the states south of the Potomac and Ohio rivers, and Arkansas, Louisiana and Texas; George Foster Peabody, treasurer; Robert C. Ogden, president.

When the charter with its broad provisions was signed by President Roosevelt, John D. Rockefeller made a special gift of $1,000,000 for exclusive distribution in educational work among the southern states, where the operations of the board were mainly confined at first. The intelligence, fidelity and efficiency with which this trust was discharged led Mr. Rockefeller, 30 June 1905, to announce a further contribution to the General Education Board of a sum of $10,000,000 to be paid October 1 of that year, in cash, or at his option in income-producing securities, at their market value, the principal to be held in perpetuity as a foundation for education, the income, above expenses and administration, to be distributed to or used for the benefit of such institutions of learning, at such times, in such amounts, for such purposes and under such conditions, or employed in such other ways as the board may deem best adapted to promote a comprehensive system of higher education in the United States. According to the success and usefulness of the fund, considerable additions in future years were promised by Mr. Rockefeller.

While the endowment is designed especially for colleges as distinguished from universities, there is no prohibition against making contributions to universities. The funds may be employed for approved non-sectarian as well as denominational schools, but in the case of the latter cannot be applied for specific theological instruction. In distributing the funds the board aims especially at favoring those institutions which are well located and which have a local constituency sufficiently strong and able to insure permanence and power. No attempt will be made to resuscitate moribund schools or to assist institutions which are so located that they cannot promise to be permanently useful.

Within these limits there are no restrictions as to the use of the income. It may be utilized for endowment, for buildings, for current expenses, for debts, for apparatus or for any other purpose which may be found most serviceable, thus providing for a great work in a practical way.

General Issue, in English law, is that plea which denies at once the whole declaration or

indictment, without offering any special matter by which to evade it. It is called the general issue, because, by importing an absolute and general denial of what is alleged in the declaration, it amounts at once to an issue, or fact affirmed on one side, and denied on the other. This is the ordinary plea upon which most causes are tried, and is now almost invariably used in all criminal cases, when the prisoner at the bar pleads "not guilty"; to money counts the plea is "never indebted"; or to actions on simple contract *nunquam assumpsit* ("never undertaken"). This plea puts everything in issue, that is, denies everything, and requires the party to prove all that he has stated. It is a frequent question, What can be given in evidence by the defendant upon this plea? and the difficulty is, to know when the matter of defense may be urged upon the general issue, or must be specially pleaded upon the record. See PLEA; PLEADING.

General Par'esis (known also as general paralysis, softening of the brain, paralytic dementia, paralysis of the insane, etc.), a disease of the nervous system that usually begins in early adult life, progresses steadily with increasing mental enfeeblement, and leads to ultimate motor paralysis, decay of all of the mental faculties, and death within a period averaging from three to five years. From the type indicated in this brief general definition there are numberless variations. It is a disease which, when well advanced, is recognized with great ease, but in its early stages it may be extremely difficult to know. From the standpoint of the patient's family and friends it is important to be able to recognize the disease; for it is in this initial period that the patient often ruins his business, his friends, his family, and brings shame and discomfort to all those connected with him. Much of this might be averted if the layman were better informed of this early period of one of the worst scourges of modern times. The disease has probably existed for many centuries, but it is only within comparatively recent times that its true character has been recognized, and in its present extreme forms it seems to be a product of the modern complex social system. It has been aptly termed a disease of civilization and *syphilization,* an alliteration that contains much truth. General paresis may develop in almost any one, but there are certain necessary antecedents and numerous contributory factors. It is believed by most students of mental diseases that syphilis is one of the most important antecedents. Accurate statistics on this point are extremely difficult to obtain, but most alienists believe that from 60 to 90 per cent of patients who have developed paresis have had syphilis. This as a purely statistical argument is of course no proof that syphilis is the cause of paresis; for probably 99 per cent of paretics have had measles, or whooping-cough; yet the changes that are found in the blood vessels of the brain in paretics are very closely allied to changes in the blood vessels known to result from the poison of syphilis. The theory of the syphilis etiology is, therefore, probably true for most cases, but not necessarily so. Another extremely important item is a characteristic mental type. In an extremely large number of paretics the mental character has been that of great emotional activity. People who use their brains very hard, and who can key them up to a high pitch, seem to succumb to this disease more than those of evener temperamental tone. It is this type, as seen in actors, in salesmen, in active business men, who become infected with syphilis, that is peculiarly liable to the disease. It is also this temperamental type that indulges in excesses of various kinds — excesses of work, of play, of excitement, of worry, of alcohol, of venery — and thus are undermined the foundations of healthy nerve-tissue, leading to its premature decay.

General paresis is commoner in men than in women, the proportion among different peoples and races, and times, varying from 25–1 to 3–1. Although it is a disease usually beginning in the thirties or forties, juvenile forms are known, and sometimes the old man is a victim. It seems to be more prevalent in crowded communities, for there the stress of excitement and depression, of gaiety and sadness, of extravagance and destitution, is more pronounced, for both extremes of the mental pendulum must be considered in the estimation of the causes of paresis. The brilliant financier, or the actress who succumbs to this disease may be more in the public eye, and moralists may adorn a tale concerning their supposed profligacy, but the poor harassed workman, diseased through lack of knowledge, and drink-sodden to escape the reproofs of his conscience, may also be the victim.

The initial symptoms are usually very insidious, although occasionally the disease appears in full-blown vigor. The previously healthy, neat, and careful workman begins to forget things. There is a period of disturbed mentality. Noises affect him unpleasantly. Undue irritability is evidenced by unwonted explosions of anger. This state may be weeks or months in its evolution, and may be confounded with a condition of overwork or overworry. In fact, such a condition is present in many tired people who never develop paresis. Added to this there are vague apprehensions in the patient's own mind of his gradually declining power; headaches, neuralgias, and vague pains may also be present; and poor sleep may be another symptom of the early stage. All of these symptoms are common to many people who have overworked, and should not occasion alarm. But when, little by little, one shows increasing carelessness in his personal habits, such as neglecting to button his trousers, or permitting his food to spill on his clothing, when he shows signs of mental exaltation and dreams of wonderful things, then the true disease begins to show itself. From this point on there are countless variations, but in general the typical paretic behavior that leads the person into economic danger, if not disaster, is characterized by an expansive and exaggerated conduct. Buoyancy and elation, with great projects and sanguine hopes, mark the initial stages of the paretic's mental decay. He becomes restlessly busy, is continually entering into new schemes, is incessantly talking about his affairs with effusive geniality, not only to his friends, but to utter strangers, and he even communicates to others his closest domestic concerns. There is a gradual breaking down of the finest sensibilities and, closely following this, slight evidences of the

loss of the most delicate motor adjustments become manifest. It is in this stage that the symptoms become unmistakable. The partial impairment of the motor functions shows itself in an increased lack of control of the finer motions of the tongue, the lips, and the hands. There is a fine tremor in the tongue when it is protruded; on showing the teeth, the angles of the mouth betray a fine tremor; and the handwriting is seen to be less firm and even, approaching that of the formative period of the man's youth. The mild grade of inflammation in the brain causes certain changes in the reflexes of the body. Thus, the pupils of the eyes are not apt to act as rapidly as in health; they may be unequal in size; they are sometimes very small and do not open wide in the dark as is usual. With these symptoms the diagnosis becomes moderately certain, and from this time on the mental degeneration becomes marked. The carelessness becomes slovenliness; the memory goes rapidly; the loss of the finer sensibilities deepens to obscenity, to faithlessness, to utter loss of the moral faculties; the buoyancy becomes foolishness, and big projects are often launched, resulting in financial ruin. Grandiose ideas usually enlarge, and the afflicted one dreams of millions of money, of being a king, or president, or Christ, or a god. His personal strength is like that of Samson, his beauty comparable to Apollo's; his voice, his oratory, his writing, his poetry, his acting are superb — in short, his whole personality is puffed up with an amazing exaltation of the ego. Exulting self-confidence dominates all his designs, and a restless, busy, subdued delirium actuates his every thought and movement. From this stage, usually termed the grandiose stage, and which may persist for from six months to a year or more, the mental deterioration commences to show itself in a gradually progressive dementia. Mental dilapidation becomes mental decay. The motor restlessness goes on to loss of power and a gradual paralysis of the motor functions begins, passing through the stages of progressively increasing inco-ordination to complete powerlessness. Tottering, shambling, stumbling incompetence finally advances to absolute motor impotence. This affects all of the muscles of the body, but is appreciated in the speech more readily and earlier than in other motor acts. The loss of ability to repeat the r's and l's, as in «truly rural,» «artillery,» etc., is an early sign of this speech-defect. Finally the only answer that can be obtained from the patient is that he is «all right.» The lack of motor power further manifests itself in the increasingly diminished control of handwriting. The paretic is unable to keep to a line. His writing goes up and down, letters and words are omitted, the up strokes are very wavy, and the letters become unequal in size.

Thus the course of the disease progresses until, in from two to three years, on the average, the paretic is a bedridden dement, who dies of exhaustion or an apoplectic or epileptiform convulsion. Occasionally remissions of the disease occur. These are particularly trying to most of the paretic's friends, for hopes of recovery receive a sudden stimulus only to be destroyed after a period of from six months to a year or so. Occasionally the remissions last a number of years, but at the present time it is believed that general paresis is a necessarily fatal disease. Alienists have a habit of calling the recovered cases pseudoparesis, a justifiable procedure in view of the many uncertainties attending the diagnosis of mental disorders.

The main features of a central type of the disease are here given, but there are countless variations. Acute maniacal states sometimes occur, and the patient dies in a galloping frenzy in from three to six months. Occasionally a paretic is melancholic or stuporous throughout. A small proportion, one half per cent of the cases, show this type. Occasionally — and many modern alienists believe this to be more common at present — a gradually progressive dementia without grandiose ideas marks the entire course of the disease. Most cases of paresis have apoplectiform or epileptiform attacks at some period of the disease. A few begin in this manner. There are countless numbers of mixed forms, the details of which may be consulted in text-books on insanity. Here also the subdivision of the disease into stages may be found.

Of the treatment little may be added. The most essential step in relation to this disease is its early recognition. To be able to know what is the matter before the patient has ruined his business, or his family and friends, is the most important feature for the layman to grasp. The paretic himself is doomed, but it is not necessary for those dependent on him to suffer irretrievable loss because of his disease. The proper course to pursue is to place the patient in a sanatorium or asylum at the earliest possible moment, the place selected depending largely on the means of his friends or relatives. Consult: Maudsley, 'Pathology of Mind' (1895); Chase, 'General Paresis' (1902); Krafft-Ebing, 'Die progressive allgemeine Paralyse' (1894); Starr, 'Organic Nervous Diseases' (1903); Ziehen, 'Psychiatrie' (2d ed. 1902); Kraepelin, 'Psychiatrie' (1900); 'Journal of Nervous and Mental Disease,' for bibliography and recent studies. See DEMENTIA; INSANITY.

SMITH ELY JELLIFFE, M. D.,
Editor 'Journal of Nervous and Mental Disease.'

General Service and Staff College, United States army, a training school for young officers of the United States army, located at Fort Leavenworth, Kan. Graduates from West Point are sent here for a further study of the profession of arms, and a more practical and theoretical training from the standpoint of the officer. Upon completing the course of study an officer returns to duty with his regiment. The course of study (1903) is one year, but, after the graduation of the class for 1904, will be extended to two years. At graduation the student class is divided into two classes, the «distinguished» class and the «proficient» class, the former becoming available for detail at the War College at Washington. The books to be used during the school year of 1903-4 are as follows: 'Horses,' 'Saddles and Bridles,' 'International Law,' 'Manual of Military Field Engineering,' 'Military Hygiene,' 'Military Law,' 'Military Topography and Sketching,' 'Organization and Tactics,' and 'Service of Security and Information.' See ARMY OF THE UNITED STATES; ARMY WAR COLLEGE.

General Sessions, Court of. See COURT.

General Staff of the Army, in the United States. History evinces that most competent and courageous commanders have at times charged failure of their operations to lack of preparation for which they were not responsible, or to ill-considered interference by those in high public office. Each successive war has developed accusations of shortcomings which though often indefinite, pointed in the main to defective organization and administration at the War Department. No two nations seem to favor identically the same methods of military administration, yet all have the same objects in view — correct organization, modern equipment, preparedness to strike the first blow with an assured and continuous supply of men, money, and war stores, during hostilities. During the early years of the United States the army was insignificant in proportions, but the business of the War Department gradually grew in volume until it was necessary to adopt some measures to save the secretary of war from being crushed by the burden of current routine work. In groping for some method which would relieve the secretary, the bureau system with numerous semi-independent chiefs was introduced. These bureaus were few in number at the beginning but gradually grew until at the commencement of war with Spain there were 10 chiefs of bureaus directly connected with the administration and supply of the army, each working along his own lines without of necessity having any knowledge of the character and extent of allied work going on in other bureaus. The army is absolutely dependent upon these administrative and supply bureaus and success depends upon the co-ordinated total of all their efforts. During a long course of years a system of laws and regulations had grown up for the governance of these bureaus. These bureaus have been controlled by many talented officers through whose honest and laborious efforts success has been made possible in the wars of the century just closed. It has gradually come to be the conviction of a large and increasing number of thoughtful and discerning officers and public men that success has been wrought in spite of the system and not altogether because of it. Chiefs of bureaus found themselves constantly hampered by reason of lack of information. Not by law but as a matter of expediency all looked to the adjutant general for information, but chiefs of bureaus claimed that the secretary of war alone was competent to give them orders or instructions.

Nations which depend upon volunteer armies are apt to ignore the lessons of war and to consider that all that goes wrong is chargeable to unusual conditions and not to lack of previous preparation. This lethargy would have supervened at the close of the brief war with Spain had not the insurrection in the Philippines and the occupation of Cuba commanded further attention to military matters. In all armies there are many important duties which by common usage have become designated as general staff duties. Much of the employment of general staff officers is in the nature of co-ordinating the action of others, but a large part is original work of the highest type. It was the lack of a corps of this kind which was always keenly felt in American army administration. It should be understood that general staff duties were not wholly neglected but their performance was spasmodic, uncertain and without fixed responsibility because executed by officers of other corps or of the line, detailed individually or as members of temporary boards.

After a patient and exhaustive study of the situation the secretary of war concluded that the more important duties of a general staff could be performed by a war college and its governing board. In furtherance of this idea a board of officers was convened to consider and recommend regulations for the establishment of an army war college. After mature study of the situation the board formulated a memorandum of an order for the execution of the project but unanimously recommended that a general staff be established by appropriate legislation which would free it from the uncertain tenure adhering to the war college which exists only by executive authority.

A continuing study of the manifold questions arising in the course of army administration brought prominently into view the never ending controversy as to the proper place of the "Commanding General of the Army" in the new scheme. The commanding general had long complained of loss of prerogatives believed to appertain to his office, while the generals commanding the geographical departments rebelled at being deprived of all initiative and being practically under the control of bureau chiefs, each naturally interested in enhancing the usefulness and dignity of his own bureau. The only solution which suggested itself as a practical and possible adjustment was the abolition of the office of "Commanding General of the Army" and the substitution of the office of "Chief of Staff," with the introduction of a new corps composed of trained officers to assist him. Out of these studies and efforts have come the law known as the General Staff Bill, which passed the Congress and was approved by the President 16 Feb. 1903.

Under this law the chief of staff, regardless of his relative rank, is the adviser and representative of the secretary of war, occupying a position between that official and the staff bureaus as well as the line of the army. Instead of 10 chiefs of bureaus and their numerous assistants having frequent interviews with the secretary concerning military affairs, the chief of staff has authority to adjust professional matters in the secretary's name. Conflicting elements of the larger administrative questions are thus brought together and harmonized without taking up the valuable time of the civilian secretary, who must of necessity acquaint himself concerning numerous technical details before undertaking to decide matters at issue. This is a decided improvement over the methods in vogue during the existence of the office of "Commanding General of the Army," for notwithstanding the title and high rank of the distinguished officers who have occupied that position, their influence and power over the army as a whole was so restricted as to be entirely incompatible with the title of their office.

It was not presumed in making so radical a change in the American military system that the general staff corps will be a panacea for all the misfortunes which may overtake a nation in war. History teaches that previous preparation and planning such as will be undertaken by the general staff will tend to render success more certain, abbreviate the period of actual hostili-

ties and thereby effect an enormous saving of life and treasure. Commercial interests of all modern communities have become so enormous and widespread that a long-continued war means national paralysis to the defeated nation. Through the agency of the general staff, military and political policies may be harmonized as becomes a republican form of government. With the war policy determined, the general staff will be responsible that each part of the army line and staff is promptly acquainted with its duty and that it does its full duty in the premises. The preparation of armies and their equipment rests with the chief of staff and the various staff corps and departments. The responsibility for manœuvring the armies and for success in battle rests with the various generals assigned to command them. In past wars it has been the custom to depend upon Congress at the last moment to enact legislation for armies and grant appropriations at a time when, by reason of popular excitement, members are least able to give to the grave questions involved the consideration necessary.

The duties of the general staff consist, in peace, to a great extent, of bureau work — including the collection of information, preparation of maps, drawing up schemes for the organization and concentration of troops, formulation of plans for the national defense and a study of the higher military science to keep pace with modern progress. Bureaus organized and prepared to handle any particular class of army business will continue to initiate action and control its affairs subject to the supervision of the chief of staff. It is in the many important matters where the work of several bureaus must be harmonized and brought into the same channel, that the general staff will find its greatest field of usefulness. The general staff will be acquainted with contemplated changes in the organization and stations of troops and by preparing timely schemes will ensure arrangements being made for transportation and supply in the most expeditious and economical manner. The arrangement of all these interlocking details is necessary to successful campaigns of any duration. Armies are constantly called upon to endure all kinds of hardships, to which they submit cheerfully so long as there is no suspicion that any one is at fault. It is expected that the American general staff will plan to minimize the chances of failure due generally to lack of previous knowledge and preparation. The statute contemplates that the general staff corps shall be composed of officers detailed for periods of four years, and it is necessary that a sufficient number be maintained on duty to furnish details with troops as well as for bureau work. This ensures a body of officers in touch and sympathy with the fighting portion of the army. The general staff corps has been so recently organized that it will require some time to develop methods of operation, but as the soldierly spirit, informed by experience derived from actual service with troops, will be the guiding impulse of this corps, the expectation that the country will be better prepared for campaigning at the outbreak of the next war than it has ever been in the past, is fully justified. See ARMY OF THE UNITED STATES.

W. H. CARTER,
Brigadier-General, Assistant Chief of Staff.

General Theological Seminary, a seminary of the Protestant Episcopal Church in the United States, established in 1817. Instruction was begun in New York city in 1819, but in 1820 the seminary was removed to New Haven. It was again re-established in New York in 1822. The gifts of Dean Hoffman to the school amounted to over $1,000,000, while in 1902 the total resources of the school were over $4,000,000. The theological course of the school extends over a period of three years, and there is a post-graduate course. The degrees of D.D. and B.D. are conferred. The control of the seminary is vested in a board of trustees composed of the bishops of the Church, 25 members elected by the general convention and certain other members elected by various dioceses. There are about 150 students in regular attendance.

Genera'tion, popularly used as a measure of time, and usually represents about 30 years, the period which man requires to attain maturity, and the age at which, as a general rule, fruitful marriages are contracted. This secondary sense of the term is thus indirectly derived from the primitive meaning, which has reference to the origin of living things. In the higher animals and plants the offspring is due to the congress of distinct individuals or elements. (See REPRODUCTION.) Alongside of this process, sometimes even concurrently with it, new forms may arise by fission, or by budding; by a process akin to the latter, as in the parthenogenesis of bees, etc.; or by a combination of the sexual and asexual processes, alternate generation.

Generation, Spontaneous. See SPONTANEOUS GENERATION.

Gen'erator, (1) An apparatus for generating carbonic acid gas for charging soda-fountains or bottles with aërated water. (2) In chemistry, a term used to denote the elements or compounds from which a more complex substance is obtained. Thus ethyl, alcohol, and acetic acid are the generators of acetic ether; and benzoic acid and glycocoll are the generators of hippuric acid. (3) In distilling, a retort in which volatile hydrocarbons are distilled from liquid or solid matters. (4) In electricity, a dynamo-electric machine (q.v.). (5) In steam, a vessel in which steam is generated from water, for use in a steam-engine, a heating apparatus, etc. The term was first applied to the Perkins steam boiler, in which water in small quantity was heated to a high temperature. It is now specifically applied to a class of instantaneous generators. The name is now rapidly coming into use for all apparatus for generating steam, being held to be more correct than the usual term. See STEAM.

Genesee (jĕn-ē-sē') **River,** a remarkable stream rising in Pennsylvania, and flowing nearly 200 miles north through western New York into Lake Ontario, seven miles north of Rochester. The Genesee is famous for its extraordinary falls. Three of these occur within a distance of 1½ miles; two are respectively 68 and 90 feet high, and the Portage Falls are 110 feet high. The river has also a sheer fall of 95 feet at Rochester, utilized for water-power; and another cascade, a few miles below, is almost as high.

Geneseo, N. Y., a village and county-seat of Livingston County, 30 miles from Rochester, on the Genesee River and the Erie R.R. The State Normal School and Wadsworth Public Library are situated here. It is an agricultural town and manufactures gloves, mittens, flour, and machines. Pop. (1900) 2,400.

Gen'esis (Greek), creation, birth, origin. The first book of the Pentateuch is named in the Hebrew canon *B'reshith* (in the beginning), from the expression with which it commences; from the 70 translators of Alexandria (those who produced the Greek version known as the Septuagint) it received the name it is now commonly known by. Genesis consists of two great but closely connected divisions: (1) The history of creation, the fall of man, the flood, the dispersion of the human race, chap. 1–xi. (2) The history of Abraham, Isaac, Jacob, and Joseph, including notices of the descendants of Abraham and Isaac in their collateral lines, chap. xii.–l. It would be entirely to mistake the character of the history of Genesis to view it as having other than a sacred purpose; yet even in a secular point of view there is no record that can be brought into competition with it. There is absolutely nothing in the whole range of ancient literature which could supply its place if this document were lost; while it is further to be observed, that if confidence cannot be placed in its authenticity, no reliable information exists on many subjects with which it is desirable man should be acquainted, and after which there is an intense longing in the human mind; as, for instance, the origin and early history of the race, a subject which, without the information supplied by Genesis, must be involved in impenetrable darkness.

Genêt, or **Genest, Edmond Charles Edouard,** ĕd-môṅ shärl ā-doo-är zhĕ-nā, French diplomat: b. Versailles, France, 8 Jan. 1765; d. Schodack, N. Y., 14 July, 1834. In 1777 he translated into French a Swedish history of King Eric XIV. of Sweden, in 1789–92, was French *chargé d'affaires* at St. Petersburg, and from 1793–4, when he was recalled at Washington's request because of attempts to compel the United States to a war with England, was French minister to the United States.

Genet, jĕ-nĕt', a civet (q.v.) of the genus *Genetta;* also a trade-name for the fur of this animal, or of some other fur like it. The best known is the common genet (*G. vulgaris*), of the Mediterranean region, called "berbe" in the south of France. It is a very beautiful and graceful animal, gray, with many dark patches, and a full furry tail, banded with black and white. The size is about that of a house-cat. Their fur is made up into tippets, muffs, etc., but is of no great value, and often domestic cat-skins are substituted under the same name.

Genet'ic Psychology, the science of the mind as dealing through observation, and where possible, through experiment with the growth and development of consciousness or intelligence in dumb animals, children, and adult human beings. It is one branch of that experimental psychology which the German philosopher Lotze was the first to inaugurate.

Gene'va, Ill., a city and county-seat of Kane County, about 33 miles from Chicago, on the Chicago, B. & Q., and Chicago & N. R.R.'s. It was settled in 1832 and was incorporated as a city in 1887. It is a popular residential section for Chicago merchants. The manufactures include windmills, glucose, sadirons, flour, and boxes. The city owns and operates its own electric-light plant and water supply. Pop. (1900) 2,446.

Geneva, Neb., a city and county-seat of Fillmore County, 60 miles west of Lincoln, on the Burlington & M. R. R.R. The State Industrial School for Girls is located here. Pop. (1900) 1,534.

Geneva, N. Y., city in Ontario County, on Seneca Lake and the Seneca and Cayuga Canal; and on the Lehigh Valley and the New York Central R.R.'s; 50 miles southeast of Rochester. Geneva has extensive manufactories of stoves, steam boilers, optical goods, cereals, canned goods, etc. There are also large nurseries and greenhouses here, occupying about 10,000 acres of land. The city is the seat of Hobart College, established in 1822 by the Protestant Episcopal denomination. The Delancey Divinity School, the Delancey School for Girls, and the State Agricultural Experiment Station are located here. Geneva was chartered as a city in 1898 and is governed by a mayor, elected every two years, and a unicameral council. The city owns and operates the waterworks. The assessed property valuation is $6,000,000. The population in 1890 was 7,557 and in 1903 11,228. In the 18th century the Indian village of Kanadesoga was located near the present site of Geneva. General James Clinton attacked and destroyed the village in 1779.

Geneva, Switzerland, a canton, bounded on the north by the canton of Vaud and the Lake of Geneva, and on the east, west, and south by the territories of France. In addition to the territory thus bounded, the communes of Celigny, Le Coudre, and Petit Bois, enclosed by Vaud, belonged to this canton, which is one of the smallest in the Swiss Confederation, the area being only 108 square miles. The whole canton belongs to the basin of the Rhône, and the only streams of importance are that river and the Arve, which joins it a little below the town of Geneva, the capital of the canton. The territory of Geneva having, by the arrangements of the Congress of Vienna, obtained an accession of 15 communes, detached from France and Savoy, was admitted a member of the Swiss Confederation in 1814, and ranks as the 22d canton. A constitution, somewhat aristocratical in its nature, was framed, and continued in force till 1830, when a considerable modification of it took place. In 1841, in consequence of a popular tumult, the original constitution was abandoned for one in which the democratic principle is completely predominant. This new constitution was modified under popular pressure in 1847. All religious denominations are declared to have perfect freedom, but two of them are paid by the state — the Roman Catholics, amounting to rather more than a third of the population, and the Protestant National Church. The language spoken is French. Pop. (1900) 131,674.

Geneva, Switzerland, the capital of the canton of the same name; at the western extremity of the Lake of Geneva, where the Rhône issues, here crossed by several bridges, and

GENEVA, SHOWING MT. BLANC.

dividing the town into two portions. The more important public buildings are the Cathedral or Church of St. Pierre, a Gothic structure of the [illegible] centuries; the town house in the Florentine style; the [illegible], containing a collection of pictures, etc.; the university building, nearly opposite the botanic garden, [illegible] and containing the public library, founded [illegible] and the Museum of Natural [illegible] and science Geneva has long occupied a distinguished place, and it has been the [illegible] of many eminent men [illegible] [illegible] the principles of the Reformation, and chiefly through [illegible] [illegible] influence over the political [illegible] France and Germany. [illegible] commune, [illegible]

Geneva Arbitration, or **Geneva Award**, the settlement of the *Alabama* claims [illegible] [illegible] and the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] in gold as the [illegible] to be paid by Great Britain to the United States [illegible] [illegible] a year.

Geneva Bible, a translation of the Bible [illegible] [illegible] the first [illegible] [illegible] [illegible] [illegible] [illegible] See BIBLE.

Geneva College, Pa., a coeducational institution [illegible] [illegible] [illegible] Church, [illegible] [illegible] [illegible] grounds and buildings valued at [illegible]; income, [illegible]; president, W. P. [illegible], A.M., D.D.

Geneva Convention ([illegible] and [illegible]), international agreement for mitigating the sufferings of war. The first was initiated by the efforts of two Genevans, a surgeon named Dunant, who wrote a [illegible] description of the [illegible] at the battle of Solferino, and a public-spirited citizen named Moynier, [illegible] [illegible] international conference held at Geneva under the presidency of [illegible] [illegible] statesman. The agreement [illegible] signed [illegible] [illegible] all the European states have since joined in it, and [illegible] [illegible] Ambulances and military hospitals [illegible] [illegible] whether they are occupied by the enemy or not [illegible] [illegible] and their [illegible] [illegible] a house with a sick or wounded soldier [illegible] [illegible] [illegible] to their own country under parole [illegible] hospitals and ambulances, to claim these rights, must carry a uniform flag with a red cross on a white ground as well as their national flag, and the staff must wear a like badge on their arms [illegible] special arrangements to be made by the commanders. In [illegible] a second convention at Geneva adopted a supplementary convention to extend the principles of the first to naval warfare, and amplify the first. It provided [illegible] [illegible] [illegible] [illegible] and their [illegible] with a red stripe; and that [illegible] [illegible] the [illegible] See [illegible]

Geneva, Lake of, or **Lake Leman** (Latin, [illegible]), the largest of the Swiss lakes, [illegible] in the form of a crescent, with its horns pointing south, between France and the cantons of Geneva, Vaud, and Valais; length, [illegible] [illegible] breadth, about [illegible] miles; area, [illegible]

square miles; greatest depth, 900 feet. It is 1,150 feet above the sea. On the north the shore is low, and the ground behind ascends gradually in beautiful slopes. On the south, and particularly at the east end, the shore is rocky and abrupt, and lofty precipices often rise sheer from the water's edge. It contains various species of fish. The water is remarkably pure and of a beautiful blue color. The Rhône, which enters the eastern extremity, a muddy, turbid stream, issues from the western extremity perfectly pellucid, and likewise of the finest blue.

Geneva, University of, a Swiss university founded in 1559, as the Academy of Geneva, and called a university only since 1873. It has 1,100 students, mostly from abroad, and the principal studies are medicine and philosophy. Women have of recent years been admitted on the same conditions as men. It is the European centre of French Protestant culture and influence.

Geneviève, zhĕn-vē-āv, **Saint,** the patron saint of Paris: b. near Nanterre, Paris, 423; d. Paris 3 Jan. 512. When yet very young she took a vow of perpetual virginity and subsequently she went to Paris. The city was about to be deserted when Attila with his Huns broke into France; but Geneviève assured the inhabitants of complete security if they would seek it in fervent prayers. Attila took his course from Champagne to Orleans, returned hence into Champagne without touching Paris, and was defeated in 451. By this event Geneviève's reputation was established. In a time of famine she went along the river Seine from city to city, and soon returned with 12 large vessels loaded with grain, which she distributed gratuitously among the sufferers. Her remains were placed in the subterranean chapel which Saint Denis had consecrated to the apostles Paul and Peter. Clovis by her request built a church over it, which was afterward called by her name, as was also the abbey founded there. Another church, consecrated to this saint, was built near the church of Notre Dame. By a decree of the National Convention, 1791, this edifice was named the Pantheon, but its original name was restored officially in 1851. Her relics, which were preserved in the former till its destruction at the Revolution, are now in the church of Saint Etienne du Mont. Her fête is held on 3 January.

Geneviève, Saint, Duchess of Brabant, wife of Siegfried, count palatine in the reign of Charles Martel (about 750). Being accused by her intendant Golo of adultery during her husband's absence, on his return she was condemned to death; but the vassal to whom her execution was entrusted allowed her to escape, and she lived six years in a cavern upon nothing but herbs. She was finally found, and carried home by her husband, who in the meantime had become convinced of her innocence. This legend is the subject of one of the finest and most perfect of the German popular tales, which appears to have been written by Emmich about 1472. The story has been retold by Tieck and Maler Müller, and dramatized by Raupach.

Genga, Girolamo, jē-rō'lä-mō jĕn'gä, Italian painter and architect: b. Urbino 1476; d. 1551. He was for many years a pupil of Luca Signorelli, whom he assisted in numerous pictures, and also of Perugino; painted a 'Resurrection' in the Church of Saint Catharine of Siena at Rome; and found a generous patron in the Duke Francesco Maria of Urbino, who finally appointed him court-architect. Among his architectural works were the church of St. John the Baptist at Pesaro, the restoration of the palace courtyard there, and the bishop's palace of Sinigaglia. With the versatility of the Renaissance, he wrote on the fine arts, and was a musician and sculptor.

Genghis Khan, jĕn'gĭs khän, or **Jenghis Khan,** Mongol conqueror: b. near the Onon River, Mongolia, 1162; d. 18 Aug. 1227. His father was chief over 30 or 40 clans, but paid tribute to the Tartar Khan. He succeeded his father when only 14 years of age, and made himself master of the neighboring tribes. A great number of tribes now combined their forces against him. But he found a powerful protector in the great Khan of the Karaite Mongols, Oung, or Ung, who gave him his daughter in marriage. After much intestine warfare with various Tartar tribes Genghis was proclaimed Khan of the United Mongol and Tartar tribes.

He now professed to have a divine call to conquer the world, and the idea so animated the spirit of his soldiers that they were easily led on to new wars. The country of the Uigurs, in the centre of Tartary, was easily subdued, and Genghis Khan was now master of the greatest part of Tartary. In 1209 he passed the great wall of China, the conquest of which country occupied him more than six years; the capital, Yenking, now Peking, was taken by storm in 1215 and plundered. The murder of the ambassadors whom Genghis Khan had sent to the king of Kharism (now Khiva) occasioned the invasion of Turkestan in 1218 with an army of 700,000 men; and the two cities of Bokhara and Samarcand were stormed, pillaged, and burned. Seven years in succession was the conqueror busy in the work of destruction, pillage, and subjugation, and extended his ravages to the banks of the Dnieper. In 1225, though more than 60 years old, he marched in person at the head of his whole army against the king of Tangut (southwestern China), who had given shelter to two of his enemies. A great battle was fought, in which the king of Tangut was totally defeated with the loss of 300,000 men. The victor remained some time in his newly subdued provinces, from which he also sent two of his sons to complete the conquest of northern China. At his death in Mongolia, his immense dominions were divided among his four sons. A great part of the empire, however, came into the hands of Kublai, who is considered as the founder of the Mongol dynasty in China. The only memorial of the conqueror now known to exist is a granite tablet discovered among the ruins of Nertschinsk. The inscription in Mongol has been deciphered by Schmidt of Saint Petersburg. It had been erected by Genghis Khan in commemoration of his conquest of the kingdom of Saratogal (better known as Karakitai).

Genii, jē'nĭ-ī, among the ancient Romans, were protecting spirits, who were supposed to accompany every created thing from its origin to its final decay, like a second spiritual self. They belonged not only to men, but all things animate and inanimate, and more especially to places,

and were regarded as effluences of the divinity, and worshipped with divine honors. Not only had every individual his genius, but likewise the whole people. The statue of the national genius was placed in the vicinity of the Roman forum, and is often seen on the coins of Hadrian and Trajan. The genius of an individual was represented by the Romans as a figure in a toga, having the head veiled, and the cornucopia or patera in the hands; while local genii appear under the figure of serpents eating fruit set before them. Quite different are the genii whose Arabic name, *Djinn* or *Jinn*, was translated by the Latin term *genius*, for want of a better word, or from the casual similarity of the sounds. See FAMILIAR SPIRITS.

Genista, jē-nis'ta, a genus of low, branching sometimes spiny shrubs, belonging to the pea family, with simple leaves and yellow flowers. There are about 80 species, a few of which are cultivated for ornament. See BROOM; DYEWEED.

Genius, in Roman mythology, a tutelary deity. See GENII.

Genlis, Stéphanie Félicité Ducrest de St. Aubin, stā-fä-nē fā-lēs-ē-tā dü-krā dė sāṅ ō bāṅ zhŏṅ-lēs, COMTESSE DE, French writer: b. Champcéri, Burgundy, 25 Jan. 1746; d. Paris 31 Dec. 1830. At the age of 16 she was married to the Comte de Genlis, and in 1770 was made lady-in-waiting to the Duchesse de Chartres. In 1782 the Duc de Chartres, afterward known as Egalité, appointed her "governor" of his children, including Louis-Philippe. She wrote a variety of works for her pupils, among others: 'Theatre of Education' (1779–80), a collection of short comedies; 'Annals of Virtue' (1781); 'Adèle and Theodore, or Letters on Education' (1782); 'The Vigils of the Château' (1784). On the breaking out of the Revolution she took the liberal side, but was ultimately compelled to seek refuge (1793) in Switzerland and Germany. When Bonaparte became consul she returned (1799) to Paris and received from him a pension. Her writings fill some 90 volumes. Among them are: 'Précis de la Conduite de Madame de Genlis' (1795); 'Chevaliers du Cygne' (1795); 'Madame de la Vallière'; the romance, 'Mademoiselle de Clermont' (1802); 'Memoirs' (1825); 'Baron d'Holbach's Dinners.' The last contains a great deal of curious but malicious information concerning the freethinkers of the 18th century.

Gennesaret, jĕ-nĕs'a-rĕt, **Lake** or **Sea.** See GALILEE, SEA OF.

Genoa, jĕn'ō-a (ancient GENUA), Italy, a fortified city, situated on the Gulf of Genoa, at the foot of the Apennines, the capital of the province and the most important seaport. While worthy of its title, "Genoa the Superb," as viewed from the sea, it is in reality built awkwardly on irregular rising ground, and consists of a labyrinth of narrow and intricate streets. Of the palaces the most famous are the ducal palace formerly inhabited by the doges, now appropriated to the meetings of the senate; and the Doria, presented in 1529 to the great Genoese citizen Andrea Doria, whose residence it was during his presidency of the republic. The palaces Brignole-Sale, Reale, Durazzo-Pallavicini, Spinola, Balbi-Senarega, and others possess great interest on account of their historical fame and architectural beauty. Many of them contain galleries of paintings: the Brignole-Sale has works by Van Dyck, Rubens, Albrecht Dürer, Paolo Veronese, Guercino, etc. Among the churches are the Cathedral of St. Lorenzo, in the Italian Gothic style; the Church of St. Ambrogio (1589), containing pictures by Guido Reni and Rubens. The marble municipal palace, built in the Late Renaissance style, with a magnificent vestibule, courtyard, and galleries, and the palace of the Dogana must also be mentioned. Genoa has a university, founded in 1243, a library of 116,000 volumes; also numerous technical schools, and institutions of higher education. The hospital, the asylum for the poor (capacity 2,200), the deaf and dumb institution, and the hospital for the insane are among the finest institutions of their kind in Italy. There are numerous excellent philanthropic foundations, as the Fieschi, an asylum for female orphans. The public library contains 50,000 volumes; and there are the Academy of Fine Arts, founded (1751) by the Doria family; the Carlo Felice Theatre, one of the finest in Italy; and the Verdi Institute of Music. Genoa is the commercial outlet of a wide extent of country, of which the chief exports are rice, wine, olive oil, silk goods, coral, paper, macaroni, and marble. The imports are principally raw cotton, wheat, sugar, coal, hides, coffee, raw wool, fish, petroleum, iron, machinery, and cotton and woolen textiles. The annual exports of Genoa are valued at nearly $20,000,000, the imports are returned at more than $75,000,000. Pop. (1901) 234,800.

The history of Genoa may be traced back in legendary traditions to a time preceding the foundation of Rome. It was one of the most considerable cities of the Ligurians, and is mentioned by Livy (under the name of Genua) as being in friendly relations with Rome at the beginning of the second Punic war. It was subdued and partly destroyed during that war by a Carthaginian fleet under the command of Mago. The Romans rebuilt it, and it afterward became a Roman municipium. After the decline of the Roman empire in the West it fell into the hands of the Lombards, and with them became subject to the Franks. After the downfall of the empire of Charlemagne, Genoa erected itself into a republic, and till the 11th century shared the fortunes of the cities of Lombardy.

If Genoa had adopted a wise colonial system she would have held the first rank among the commercial nations at the end of the Middle Ages. After the conquest of Constantinople by Mohammed II. in 1453, the Genoese soon suffered for the aid they had imprudently afforded the Turks. Mohammed took from them their settlements on the Black Sea in 1475, and at length all access to this branch of trade was denied them by the Turks.

While the power and commercial rank of Genoa were attaining their height by means of their foreign trade and acquisitions of territory the city was internally convulsed by civil discord and party spirit. The hostility of the democrats and aristocrats and the different parties among the latter occasioned continual disorders. In 1339 a chief magistrate, the doge, was elected for life by the people, but he had not sufficient influence to reconcile the contending parties. A council was appointed to aid him; yet after all attempts to restore order to the state, there was

no internal tranquillity; indeed, the city sometimes submitted to a foreign yoke in order to get rid of the disastrous anarchy which the conflict of parties produced.

In 1528 the disturbed state regained tranquillity and order which lasted till the end of the 18th century. The form of government established was a strict aristocracy. The doge was elected to be the head of the state. The nobility were divided into two classes — the old and new. To the old belonged, besides the families of Grimaldi, Fieschi, Doria, Spinola, 24 others who stood nearest them in age, wealth, and consequence. The new nobility comprised 437 families. The doge might be taken from the old or new nobles.

Little by little Genoa lost all her foreign possessions. Corsica, the last of all, revolted in 1730 and was ceded in 1768 to France. When the neighboring countries submitted to the French, in 1797 the neutrality which the republic had strictly observed did not save the fluctuating government from ruin. Bonaparte gave to them a new constitution formed on the principles of the French representative system. Two years afterward a portion of the Genoese territory fell into the hands of the Austrians; but the fate of Genoa was decided by the battle of Marengo. A provisional government was established, and in 1802 it received a new constitution as the Ligurian republic and acquired some increase of territory, and had in 1804 a population exceeding 600,000. Its naval force, which was so formidable in the Middle Ages, at last dwindled down to a few galleys and barques; the land force became almost equally insignificant.

On the overthrow of the French empire Genoa was occupied by the British, with whose permission the ancient constitution was re-established. But the Congress of Vienna in 1815 assigned Genoa with its territories to Sardinia, stipulating that it should have a sort of representative constitution. In 1821 it joined for a moment the revolutionary movements of Italy. In the spring of 1849, after the defeat of Charles Albert at Novara and the conclusion of a truce with the Austrians, a revolutionary outbreak took place, the national guards occupied the forts, and the garrison was compelled to withdraw. A provisional government was formed and the independence of the republic was proclaimed. But a large body of Sardinian troops under Gen. Della Marmora, soon appeared before the city; a bloody struggle ensued and the forts and principal points of the city were taken by the royal soldiery. Meanwhile a deputation was sent to Turin, which returned with the amnesty of the king, excluding the chief leaders of the movement, who, however, escaped on board an American vessel. In April the city was disarmed and the monarchical government restored. Following the fortunes of the Sardinian states, Genoa became a portion of the kingdom of Italy. Pop. (1901) 234,710.

Genoa, Gulf of, a large indentation in the north shore of the Mediterranean, north of Corsica, having between the towns of Oneglia and Spezia a width of nearly 90 miles.

Genre (zhŏṅ-r) **Painting,** in art, from the French *genre* (sort or kind), which was originally employed to designate pictures of which the subjects were copied directly from nature, such as landscapes, scenes of every-day life, animals, fruit, and even portraits; in contradistinction to those which were more the product of the imagination, such as historical, religious, and purely ideal paintings. The term is now restricted to denote scenes of every-day life, such as Hogarth and Wilkie loved to depict. A genre painter is not confined to low subjects, nor need his paintings be vulgar in the ordinary acceptation of the word, though the great modern masters in this style, the Dutch, have owed their inspiration and fame to scenes of very humble and often coarse life. This style of painting was not unknown to the ancients. Pyreicus, a Greek painter of the time of Alexander the Great, painted barbers' shops, cobblers' stalls, and the like, and according to Pliny, his pictures were highly prized. In Italy the painters who have worked in this style are Caravaggio, Manfredi, Salvator Rosa, Benedetto Castiglione, etc. But the art received its highest development in the Netherlands; Teniers the younger, Jan Van Mill, D. Ryckaest, Rembrandt, Nicolas Maas, Gerard Dow, Jan Steen, the Van Ostades, Brauwer and Bega, are among the best exponents of the style. In Spain the most notable genre painters are Velasquez and Murillo; and in Great Britain, after Hogarth and Wilkie, already mentioned, come Leslie, Mulready, Maclise, Egg, Millais, Faed, and others. The British school has sought to lend a dignity to the style by the introduction of the dramatic element. See PAINTING.

Genseric, jĕn'sėr-ĭk, king of the Vandals: d. 477 A.D. Under Genseric the Vandals first became formidable at sea, and gained possession of parts of the islands of Sicily, Sardinia, and Corsica. In 455, on the invitation of the Empress Eudoxia, Valentinian's widow, who sought his assistance against Maximus, he landed at Ostia and marched to Rome, which he stormed and gave up to pillage for 14 days. On his departure he carried off the empress herself and her two daughters, one of whom he married to his son Hunnerich.

Gen'tian, the dried rhizome and root of *Gentiana lutea.* This is the yellow gentian of Europe, a tall mountain perennial, growing abundantly in southern and middle Europe and Asia Minor. The chief source of supply to the drug market is collected from Switzerland, southern France, and the hilly portions of Germany. The main constituent of the root is a bitter glycoside, gentiopicrin. It also contains sugar, gums, and salts. The action of gentian is that of a simple bitter and it is used to improve the appetite and thus secondarily affect the general constitution.

Gentile, Da Fabriano. See FABRIANO, GENTILE DA.

Gen'tiles, in Scripture, all the nations of the world, excepting the Jews. In modern usage all the nations excepting Jews and Mormons. In the Old Testament it is the rendering of the Hebrew word *goim,* peoples, nations, the plural of *goi,* a nation, a people. At first it was used as a mere ethnological word, and quite respectfully, but as the Jews became more conscious of their privileges they employed it more and more scornfully of the nations around (Gen. x. 5; Isa. lxvi. 19; Jer. xiv. 22). In the New Testament Gentiles is the rendering of the Greek *ethne,* the plural of *ethnos,* a number of people living together, a nation. St. Peter,

moved by a vision, was the first of the Twelve to preach to the Gentiles (Acts x.), but the Apostle of the Gentiles was Saint Paul (Gal. ii. 15).

Gentry, Meredith Poindexter, American politician: b. Rockingham County, N. C., 1809; d. 1866. In 1839 he was elected to Congress as a Whig, and he was also a representative from Tennessee in 1841–3, 1845–7, and 1847–53. In 1862 and 1863 he was a member of the Confederate Congress. He was a student of political history and well known as a speaker both in and out of Congress, a eulogy of Henry Clay being among his noteworthy public utterances.

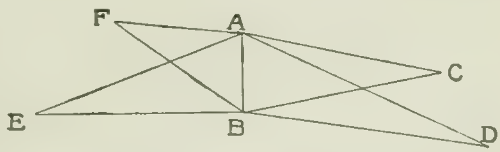
Gentz, Wilhelm Karl, vĭl'hĕlm kärl gĕnts, German painter: b. Neuruppin, Brandenburg, 9 Dec. 1822; d. Berlin 23 Aug. 1890. He traveled in Spain, Morocco, and Egypt, depicted Oriental civilization and the life of the desert with increasing insight and success, and at first turned his attention to the rendering of biblical scenes in the spirit of the actual East. Of the works of this period are: 'Christ in the House of Simon'; 'Christ among the Pharisees and Publicans.' Despite the skill with which he rendered the brilliant light effects peculiar to those regions, his work was slow in making its way. Ultimately, however, he was ranked not at all inferior to the most distinguished French colorists. He was a professor in the Berlin Academy, from 1877 a member of the Senate; and obtained the great medals of Berlin (1866), Vienna (1873), and Munich (1876). In 1873 he visited Palestine to make local studies for his greatest achievement, 'Entry of the German Crown Prince into Jerusalem, 1869,' which was completed in 1876 and hung in the National Gallery of Berlin. Other of his canvases are: 'Mecca Caravan at Prayer'; 'Meeting of Two Caravans in the Desert'; 'Evening on the Nile'; 'Funeral Celebration at Cairo'; 'Serpent Charmer'; 'Alley of Sphinxes in the Thebaid'; 'Bazaar in Algiers'; 'Palm Sunday in Early Christian Times.' He published 'Briefe aus Aegypten und Nubien' (1853).

Genuflection, jĕn-ū-flĕk'shŏn, the act of bending the knee in reverence or adoration. In the Roman Catholic Church the members genuflect when passing before the tabernacle where the Blessed Sacrament is reserved. If the Blessed Sacrament is exposed a double genuflection (on both knees) is usual. Genuflection is used at various times during the church services. The early Christians prayed standing on Sundays, and from Easter till Pentecost, and only bent the knee in sign of penance; hence a class of penitents were known as *Genuflectents.* In the rubrics of the Anglican Church double genuflection, or kneeling, is enjoined in some parts of the service.

Genung, John Franklin, American clergyman and scholar: b. Wilseyville, N. Y., 27 Jan. 1850. He was graduated from Union College in 1870, from the Rochester Theological Seminary in 1875, and from the University of Leipsic, Germany, in 1881; was for a time active in the ministry of the Baptist Church, and later was appointed professor of rhetoric in Amherst College. His publications number: 'Tennyson's In Memoriam: Its Purpose and Structure' (1883); 'Practical Elements of Rhetoric' (1886); 'Hand-Book of Rhetorical Analysis' (1888); 'The Epic of the Inner Life,' a new translation with annotations, of the Book of Job (1891); 'Outlines of Rhetoric' (1893); 'The Working Elements of Rhetoric' (1902).

Genus, jē'nŭs, in zoology and botany, a systematic term applied to any group of species (q.v.) lower in rank than a tribe, sub-family, or family. A genus may be composed of a single, several, or many species. Genera usually differ from species in structural details, while species differ in size or color, or in the structure of some special organ or portion of the body. It is, however, often difficult to draw the line between genera and species. As an example of a genus may be cited *Equus,* or the horse genus, represented by *Equus caballus,* the domestic horse; *Equus asinus,* the ass; *Equus zebra,* the zebra, etc. A genus may be represented by species inhabiting different continents, but usually a genus is confined to a single geographical realm or region. See paragraph on *Classification* in ANATOMY.

Geodesy. The science of measuring large portions of the earth's surface, continents, countries, etc., with a view to determining the form and dimension of our globe and of making maps of extended regions of its surface, differs from surveying (q.v.) in the wider regions which its scope includes, and in the corresponding necessity of more delicate and refined instruments and methods. As an example of the problem it involves: If a map of the United States is to be made, one of the many questions arising would be that of the exact distance on the earth's surface between two cities. This is obviously impossible of measurement in the familiar way with the tape line. To carry out such measurements the method of triangulation must be applied. To do this, two points must be found a few miles apart so situated that the distance between them can be directly measured on the ground, and that from each of them several different points in the region to be surveyed



are visible. Let AB be the two points chosen and C, D, E, F, etc., some of the distant points. The line AB is called the *base line* of the triangulation, and is measured by means of rods closed in wooden cases to protect them from rapid changes of temperature, which are successively placed end to end from the point A to the point B. Recently it has been found that steel tape can be used much more expediently and with all the precision that is required for the purpose. Having found the exact length of the base line, a theodolite is mounted at A and vertical rods or signals are erected at B C, so that the angle BAC can be measured with the greatest possible exactness. Then the theodolite is carried to the point B and the angle is measured in like manner. If practicable the theodolite may also be mounted at C in order to measure the remaining angle of the triangle. The sum of the angles should come out 180°,

this being the sum of the angles of any plane triangle. These three measurements will show any error in the measurement of the angles. Knowing the three angles and of the side of the triangle, the computation of the two remaining sides is a very simple one in trigonometry.

Commonly there will be a number of points, C, D, E, F, etc., which can be determined at the same time. Having done this, any of the lines from A or B to C, or between any two of the other known points, may be used as a new base line and the distance of yet other visible points measured in the same way. These, again, can be used as new base lines, and so on indefinitely. This method is especially expeditious in mountainous regions, where observations can be made from peak to peak at distances sometimes exceeding 100 miles.

Measures of this sort have been carried on or are in progress in most civilized countries. In our own country a system of triangles has been extended from the Atlantic to the Pacific coast, near the parallel of 40° latitude, by the United States Coast and Geodetic Survey. The same survey has carried a line of triangles along the Gulf of Mexico and up the Atlantic coast to the Eastern States, and they are in progress through other parts of the country. The result of these measurements is that the exact position on the earth's surface of a great number of high or prominent points are defined so that they can be laid down on maps. This done, the process of triangulation and surveying can be applied to determine the position of intermediate points, cities, towns, etc., and to determine the course of rivers or valleys.

In order to obtain the most exact result from a geodetic survey of the kind described, the exact form and size of the earth must be known. These cannot be determined in the best way through observations in any one country, but require a combination of the geodetic surveys of various countries as widely separated as possible. With a view of securing co-operation in the solution of the problem, an International Geodetic Association was formed, comprising the United States and the leading countries of Europe. This association, represented by members from the various countries, meets from time to time to carry out the co-operative work of the association, and decide upon the best way of combining the several geodetic surveys.

A fundamental point in which geodesy differs from surveying is in the combination of measurements of the earth's surface, with observations of the stars; the object of the combination is the determination of the curvature of the earth's surface and the size of our globe.

The principle involved will be readily seen by a little careful thought. It is obviously impossible to determine with any exactness the curvature of the earth's surface by observations made solely on that surface. But the surface of the ocean, which is taken as the basic one, is everywhere perpendicular to the plumb-line. It follows that the angle between the directions of the plumb-line at two points will be equal to the curvature of the ocean surface between the points. By skilful astronomical observations it is possible, on any part of the solid earth where an instrument can be mounted, to determine the exact declination in the celestial sphere from which the plumb-line points, which is, in fact, the zenith. The declination of the zenith is the latitude of the place; it follows, that if the latitude of two points north and south of each other is accurately determined, and found to be one degree, for example, the distance between them is the measure of one degree on the earth's surface. This distance can be determined between any two points which are connected by a geodetic measurement. The difference of longitude may also be determined astronomically by telegraph and by geodetic measurement of the earth's surface. The relation between the two measures shows the curvature in the east and west direction.

One of the most difficult questions connected with the figure of the earth is that of the exact ellipticity or flattening of our globe. The precise figure of the earth itself does not admit of definition on account of the irregular outlines of the mountains. Hence, as a basis of all exact statements, geodesy takes, as a standard body representing the earth, the figure that would be formed by the surface of the ocean if the continents were removed so that the ocean would cover the whole globe. It is clear that if the earth did not rotate on its axis, the form assumed by an ocean covering it would be that of a sphere. But, owing to the rotation, the equatorial regions of the earth are expanded and the polar regions contracted so that the ideal form is that of an ellipsoid. If all parts of the earth were of the same density this ellipsoid would be easily determined; but owing to the inequality of density of different parts of the earth, the figure of the ocean itself is not an exact ellipsoid. The best that can be done is to make the calculations assuming it to be such, and to make the best allowance that we can for such small deviations as may be discovered.

When Newton propounded the law of gravitation, the flattening of the earth at the poles was seen to be a natural result. But the French contended that the earth was actually elongated toward the poles. To settle the question one of the most celebrated expeditions in geodetic history was sent to Peru to measure an arc of the meridian near the equator, and another expedition went to Lapland to measure one near the poles. The results showed Newton's theory to be correct, and since that time there has been no doubt on the subject. But the difficulty of determining the exact length of a degree and the irregular variations in the figure of the earth, which we shall soon mention, are such that the determinations by geodetic measures have not been altogether satisfactory. Another method is afforded by the force of gravity, as determined by the length of the seconds pendulum. It is well known that gravity is less in the equatorial regions of the earth than at the polar regions, from two causes. One is the centrifugal force of the earth's rotation, and the other is the greater distance of the centre of the earth's surface at the equator. The result is that a clock pendulum, swinging exact seconds near the pole, would lose several seconds a day when taken to the equator; hence, a pendulum which would beat exact seconds must be made continually shorter as we approach the equator. The determination of its length in various latitudes thus becomes an important problem in geodesy. When it is known, the ellipticity or flattening of the earth may be determined from it.

What makes all the problems associated with this so complex are the small irregularities in the direction and force of gravitation wherever measures and determinations have been made. It is always found that when the latitudes of places are determined by the direction of the plumb-line, which is the only astronomical method, they seldom agree with the differences between the places as determined by geodetic measurements. The reason is, that the plumb-line is deflected by the attraction of mountains and denser portions of the interior of the earth which do not admit of exact computation. These irregularities are greater in mountainous regions, in the Himalayas sometimes rising to 30 seconds. But even in plain countries deviations of 2 or 3 seconds are found. The errors arising from these deviations would not be important in themselves, the difficulty being that they operate like a small error in a foot rule when the latter has to be used for measuring a very long stick of timber. In such a case an error even so small as one eighth of an inch in the rule would amount to an error of a foot in measuring a pole 100 feet long. As the measurement of a whole continent, even of the earth itself, has to start from short base lines, the error may be multiplied many fold in the final result.

SIMON NEWCOMB.

Geodetic Surveying. See SURVEYING.

Geoffrey (jĕf'ri) **of Mon'mouth** (called also GEOFFREY AP ARTHUR), English chronicler: b. probably at Monmouth about 1100; d. Llandaff 1152 or 1154. According to Leland he was educated at Monmouth, in a convent of the Benedictines, whose society he entered. He was afterward made archdeacon of Monmouth, whence he was, in 1152, raised to the bishopric of Saint Asaph. The state of affairs in North Wales induced him to retire to the court of Henry II. He wrote various works; but his 'Historia Regum Britanniæ' is his most important production. This is now known to be, as the compiler states, chiefly a translation from Armorican manuscripts discovered in Brittany by Walter Calenius, an archdeacon of Oxford. It contains a pretended genealogy of the kings of Britain from the time of the fabulous Brutus, or Brute, the Trojan, to the death of Cadwallader, king of Wessex, in 688. It was first printed by Ascenius, at Paris, in 1508. An English translation by Aaron Thompson, at London in 1718, was reprinted in Bohn's Antiquarian Library, 1848. We are indebted to Geoffrey for preserving, and perhaps reconstructing, the legends of Arthur and his knights, the exquisite fiction of Sabrina introduced into Milton's 'Masque of Comus,' the subject of Shakespeare's 'King Lear,' and many of the finest episodes in Drayton's 'Polyolbion.'

Geoffrin, Marie Thérèse Rodet, mä-rē tā-rēs rō-dā zhō-frăñ, the holder of a noted Parisian literary salon: b. Paris 2 June 1669; d. there 6 Oct. 1777. By the grace and vivacity of her manners, aided by a refined and cultivated taste, she drew around her all the fashion, wit, and learning of Europe. Early left a widow, with an opulent fortune, her charities to the poor, and her benevolent aids to literature, endeared her as much to society as her wit and virtue delighted. In her house the best society in Paris was assembled. Cultivated minds of every description found access to her. None could there claim a preference: the mistress of the house herself was far from desiring any precedence; she was only amiable and animating. Three of her friends, Thomas, Morellet, and D'Alembert, dedicated particular writings to her memory, which, with her treatise, 'Sur la Conversation,' have been republished.

Geoffroy Saint Hilaire, Etienne, ā-tē-ĕn zhō-frwä săñ-tē-lăr, French naturalist: b. Etampes, France, 15 April 1772; d. Paris 19 June 1844. He was educated at the colleges of Navarre and Lemoine, and became a favorite pupil of Haüy. At the age of 21 he obtained the chair of zoology in the Parisian Jardin des Plantes. As a member of the Egyptian expedition in 1798 he founded the Institute of Cairo, and returned about the end of 1801 with a rich collection of zoological specimens. In 1807 he was made a member of the Institute, and in 1809 professor of zoology at the Faculty of Sciences. He devoted himself especially to the philosophy of natural history. Among his principal works are: 'The Principle of Unity in Organic Composition' (1828); 'Philosophy of Anatomy' (1822); 'Natural History of the Mammifers' (1819–37); 'Ideas of Natural Philosophy' (1838).

Geoffroy Saint Hilaire, Isidore, French physiologist and naturalist, son of the preceding: b. Paris 16 Dec. 1805; d. there 10 Nov. 1861. He devoted himself to natural history, and in 1824 was appointed assistant to his father at the Jardin des Plantes. He was elected to the Academy of Sciences in 1833, and afterward became successively inspector-general of the university, member of the council of instruction, and professor of zoology at the Academy of Sciences. One of his chief works, 'History of Anomalies of Organization in Man and the Animals' (1832–7), adds valuable confirmation to the theories of his father. He was the means of founding the Acclimatization Society of Paris. He paid much attention to the domestication of foreign animals in France, as appears from his treatise 'Domestication et Naturalisation des Animaux utiles' (1854), and advocated the use of horse flesh as food in his 'Lettres sur les substances alimentaires' (1856). He also published an excellent life of his father under the title 'Vie, Travaux, et Doctrine scientifique d'E. Geoffroy Saint Hilaire' (1848).

Geognosy, jē-ŏg'nō-sĭ, a name under which are included those branches of geology which have to do strictly with the elements of which the earth, the sea, and the air are composed, and their various combinations. Hence it more particularly deals with rocks and rock-forming materials, and embraces much that is included in the study of petrography (q.v.). See GEOLOGY.

Geographer of the United States. The Continental army in the Revolution had a geographer to make maps and plans; and on 4 May 1781 Thomas Hutchins (q.v.), a protégé of Franklin's, was on his recommendation appointed geographer to the Southern (Greene's) army. After the peace, Hutchins was retained as United States geographer, in connection with the surveys of the western lands ceded by the

States; the first official note of the office is in the draft of the general land bill reported 26 April 1785, where it is referred to as existing, and shortly afterward Hutchins is referred to as occupying it. He was to supervise the State surveyors appointed by Congress, suspend them if unsatisfactory, and report to Congress. He was reappointed in 1788, for two years, but died the next year.

Geograph'ical Conquests. The 3d century after the discovery of America drew to its close with a veil of darkness still shrouding half the globe from the eye of civilized man. A Strabo or a Ptolemy, if questioned in 1800 as to how much of the earth's surface he could describe with accuracy, would have had to confess that he was quite familiar with only one of the grand divisions, and that one embracing only a tithe of the land of our planet. He might perhaps have claimed that he could make a tolerable map of South America, whose interior had been partly opened up by the zeal of the Jesuit missionaries. It would, however, have been full of great voids representing regions unknown to him. He would have been able also to construct a map of Asia, approximately reproducing its main features, but his outlines would have been merely the framework of blurred and empty pictures. The Himalayas had not been measured — the Andes figuring as the highest mountains on the globe. There was a boundless area within the Chinese empire untrodden by Europeans. In Asiatic Turkey, Persia, and in Afghanistan, in Turkestan, and the Pamir, there were whole regions removed from the ken of cartographers. Scant information existed regarding Japan, Farther India, and the Malay Archipelago; next to nothing was known about Korea, and the interior of Arabia was almost a blank. Australia was still floating as a cloud on the horizon. Most of the lands north of America had not yet been discovered, and the Antarctic realm had barely been touched.

The accurate knowledge of Africa was limited in the main to a narrow strip along the coast. As for the interior, comprising about one fifth of the earth's land surface, geographical learning had hardly begun to outgrow its mediæval estate. Cartographers had been groping their way amid the confused reports of traders, slave dealers, and missionaries. The feature of Equatorial Africa regarding which the most correct conjecture had obtained for centuries, was the source of the Nile, which river, in accordance with the teachings of Ptolemy and the old Arab geographers, was represented on the maps as issuing from some lakes in the heart of the continent, fed by the Mountains of the Moon. Geographers knew of a great river that flowed by Timbuktu, the Queen of the Desert, and which they called the Niger, a name handed down from the time of the ancients. It had long been supposed that this stream had a western course and that the Senegal and Gambia formed its delta. A counter theory was that it flowed east to a large lake, a view based in part on vague reports about Lake Tchad. Still another theory regarded the Niger as one of the great arms of the Nile. The Kongo was known only in the last portion of its interminable course, though as far back as the 17th century the opinion had been entertained that it issued from the same quarter of the continent as the Nile. The Sahara remained untraveled by Europeans, except near its margin, and the great lakes of Africa were known only through tradition or vague report.

In North America, the region between the Mississippi and the Pacific and north of New Mexico still belonged in great part to the realm of fancy. British America remained in great part unexplored, and the coast of Alaska had barely been grazed. There were whole regions, like the Adirondack wilderness, included within the bounds of the original States of the American Union, which were still sealed to geographers.

Nearly 300 years after the tracing of the coast line of Africa was completed by the voyages of the Portuguese, the systematic exploration of the interior may be said to have commenced in 1788 with the foundation in London of the African Association, an event which inaugurated a new era in the history of geographical discovery. This society had the good fortune to command almost at the start the services of the intrepid Scotchman, Mungo Park. Before this, it is true, the pioneer of modern African exploration, Sir James Bruce, had made his memorable journey along the Blue Nile, and the ornithologist, Le Vallant, had traveled in the hunting grounds of South Africa. Just before we hear of Mungo Park, the record of discovery also tells of a narrow wedge driven toward the heart of the continent in the journey of Browne from Assuan to Darfur. The African Association assumed for one of its first tasks the unraveling of the mystery of the Niger. The journeys of Mungo Park (who perished in the stream in 1806), of Clapperton and Denham, and of Lander, covering together the period from 1795 to 1830, revealed the course of the river. The French, meanwhile, explored the Senegal and Gambia. At this time English explorers began to push from the Guinea coast into the warlike kingdoms of Ashanti and Dahoney. In 1826 the ill-fated Laing, and in 1828 Caillié, succeeded in reaching Timbuktu, that mysterious seat of Islamism which had for centuries fascinated geographers. (See FIGS. 1 and 2.)

The close of the 18th century was the beginning of a new era in the annals of American exploration. The travels of Alexander von Humboldt between 1799 and 1804 in the basins of the Orinoco and Magdalena, and in the Andes and Mexican Cordilleras, mark an epoch in the history of geography and natural science. His work was taken up and extended to other regions, especially Brazil, by eminent naturalists like Maximilian of Wied, Spix, Martius, Auguste de Sainte-Hilaire, Orbigny, and Pöppig. These had worthy successors in the brothers Schomburgk (British Guiana), Darwin (Patagonia, Tierra del Fuego), Avé-Lallemant (Brazil), Tschudi (Andes, Brazil), Castelnau (Brazil, Bolivia, Peru), and Burmeister (Brazil, Argentina).

By the acquisition of the Louisiana territory in 1803 the United States came into possession of a boundless domain, in great part as far removed from the knowledge of white men as the heart of Africa. (See FIGS. 5 and 6.) An exploring expedition was immediately sent into this *terra incognita* under Lewis and Clark, who

Fig. 1.—Africa as known in 1800. The darkened portions in this and succeeding maps show the unexplored areas.

Fig. 2.—Africa as known in 1900.

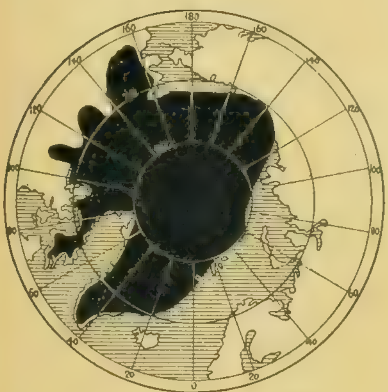


Fig. 3.—Arctic Regions as known in 1800.

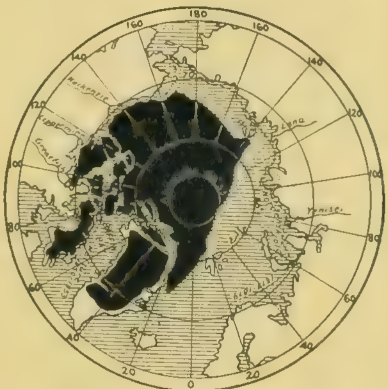


Fig. 4.—Arctic Regions as known in 1900.

Fig. 5.—North America as known in 1800.

Fig. 6.—North America as known in 1900.

proceeded up the valley of the Missouri, crossed the divide of the Rocky Mountains, and followed the Columbia down to the sea. The explorations of Pike, Long, Bonneville, Catlin, Nicollet, and Frémont, the opening of overland routes to Utah and California, and the government survey for a Pacific railway made deep rifts in the trans-Mississippi region; but its greatest wonders were to remain enshrouded till the tide of colonization had begun to sweep over the whole area. It was not till 1832 that the Mississippi river was traced to its source by Schoolcraft.

The exploration of the Arctic regions, in the hope of finding a north water route for the trade with the East, had lost much of its fascination by the 18th century. Russia alone prosecuted it systematically in the course of that century, accomplishing a great work in tracing the coast line of Siberia. About the beginning of the 19th century the idea of a Northwest Passage was revived in England and the dream of reaching the pole began to be entertained. (See FIGS. 3 and 4.) A great and persistent onslaught on the frozen North was inaugurated in 1818. The labyrinth of islands, peninsulas, and ice-bound passages north of the American continent yielded up its intricacies to the assaults of Parry, the two Rosses, Sir John Franklin (to whose tragic end Arctic discovery owed much of its rapid progress), McClure, Kane, McClintock, and Hayes. The exploration of Arctic British America was prosecuted on land with heroic energy by Franklin, Back, Richardson, Beechey, Dease, Simpson, and Rae. Parry in an attempt to reach the pole in 1827 dragged his sledges over the floating ice fields to the parallel of 82° 45′, eclipsing all previous records by more than a degree of latitude. In 1831 James Clark Ross solved the mystery of the position of the north magnetic pole, which he located in the peninsula of Boothia. McClure entered the Arctic Ocean through Bering Strait in 1850, proceeded east, was beset for years in the ice, joined hands in 1854 with an expedition which had come in the opposite direction, and thus carried off the laurels of the Northwest Passage. While a great breach was being made in the Arctic fastnesses, Bellingshausen, Weddell, Dumont d'Urville, Sir J. C. Ross, Wilkes, and others extended geographical discovery into the Antarctic regions. Ross discovered Victoria Land, with its active volcanoes, and in 1842 advanced beyond the 78th parallel. During this same period the cruel depths of Australia, whose coast had been explored by Flinders in 1801–3, were invaded by Sturt, Eyre, and the ill-fated Leichhardt.

A flood of light was thrown on the geography of Northern and Central Asia in the first half of the 19th century by the journeys of Ermann, Humboldt, Middendorf, Huc (who entered Lhassa, the holy city of Tibet), and others; while men like Webb, Moorcroft, and Wood scaled the heights of the Himalayas and the Pamir, and reached the head streams of the Indus, Ganges, and Amu Daria. From 1848 Mount Everest, with the 29,002 feet given to it by the trigonometrical measurement of Sir Andrew Waugh, figured as the highest point on the globe. Among the naturalists who were attracted to the Himalayas, the name of the botanist Hooker stands pre-eminent. The most distinguished traveler in southwestern Asia in the early part of the century was Burckhardt, who succeeded in entering the holy places of Mecca and Medina. In 1829 Ararat was ascended by Parrot. In 1832–3 Alexander Burnes performed his famous ride from India to Bokhara. The travels of Crawfurd and MacLeod in the second quarter of the century dispelled in part the obscurity hanging over farther India. Between 1835 and 1849 the naturalist Junghuhn explored Java and parts of Sumatra. Among his successors in the Malay Archipelago were St. John and Wallace.

Down to the time of the French Revolution, Europe had hardly dared to cast a covetous eye on the interior of Africa. Portugal, England, and France held sway at a few stations along the coast. The sturdy Boers, near the Cape of Good Hope, alone represented actual colonization by Europeans. The Revolution brought in its train Bonaparte's conquest of Egypt, the first great onslaught on African territory on the part of Christendom in modern times. The consequences of the French domination, brief as it was, were far-reaching in the loosening of Turkey's hold upon that country. Another result of the wars of the Revolution was the supplanting of Dutch dominion at the Cape by that of England. An army of ardent missionaries now made their way into the interior of South Africa. While England was laying the foundations of an empire at this end of Africa, France suddenly invaded the north and conquered Algeria (1830–48). A few years before this invasion, Mehemet Ali, viceroy of Egypt, brought Nubia and Kordofan under his sway. This ambitious potentate, who, for the first time since the days of Saladin, made the aggressive power of Africa felt in another continent, in his role of modernizer of Egypt, sent various scientific expeditions to explore the Nile, which was now traced almost to the equator. To this period of African exploration belong the travels of Rüppell, the brothers Abbadie, Beke, and Krapf in Abyssinia.

With the middle of the 19th century commences an extraordinary era in the history of geographical discovery. The world begins to close in upon the dark interior of Africa which is assailed on every side, and in the course of a generation the great features of the continent are unfolded almost in their entirety. In 1847 the German missionaries Krapf and Rebmann discovered the snow-capped peaks of Kilima-Njaro and Kenia, near the equator. In 1849 Livingstone discovered Lake Ngami, in the heart of South Africa, at a distance of 1,000 miles from Cape Town. In the course of the next seven years he extended his explorations to the Upper Zambesi, of which mighty stream hardly anything had hitherto been known, followed it up, struck out west along the edge of the Kongo basin (a circumstance unknown to him), made his way to the Portuguese possessions on the Atlantic, then, turning back, followed the Zambesi down stream, discovered the Victoria Falls, the rival of Niagara, and came to the shores of the Indian Ocean. While Livingstone was drawing a luminous trail across South Africa from sea to sea, Heinrich Barth was lifting the veil from the depths of the continent on the other side of the equator by his extraordinary journeys in the west half of the Sudan. In the sixth and seventh decades of the century large accessions were made to the knowledge of the

Nile basin and the surrounding regions, including Abyssinia, by the travels of Petherick (who explored the basin of the Bahr-el-Gazal), Munzinger, Beurmann, Heuglin, and others. In the meanwhile the French were pushing into West Africa on the side of Senegambia, Du Chaillu traveled in the country back of the Gabun and through the wilds of the Ogowe, the home of the gorilla and the pygmy Obongo; Burton scaled the peak of Kamerun, and Von der Decken explored what is now British East Africa.

Just as Barth was emerging from the scorching suns of Central Africa, laden with the knowledge of countless peoples, in another continent three equally intrepid Germans proceeded to explore the most elevated region of the globe. The brothers Schlagintweit crossed the Himalayas and the Karakoram, traversed the lofty plateau of Tibet, and surmounted the Kuenlun, reaching heights to which no traveler had ever climbed.

Soon after Livingstone's traverse of South Africa, the beginning was made of those discoveries which unraveled the most interesting problem presented by the geography of that continent. In 1858 Burton and Speke, despatched by the Royal Geographical Society in quest of a great reservoir of fresh water which was believed to exist somewhere in the region whence the Nile issued, discovered Lake Tanganyika. Before the close of that year, Speke discovered a still larger lake, the Ukerewe, or Victoria Nyanza, which he assumed to be a reservoir of the Nile, though as yet its outlet remained to be found. To what river system, if any, Lake Tanganyika belonged was a problem which was to wait still many years for a final solution. In 1859 Livingstone came to the shores of a third great lake, the Nyassa, a feeder of the Zambesi. Within the next five years the question of the sources of the Nile was approximately settled by the explorations of Speke, Grant, and Baker. The last named, ascending the river from Egypt in 1864, discovered the west of the Nile reservoirs, the Mwutan Nzige, or Albert Nyanza. What Ptolemy had laid down on his famous map 1,700 years before was found to be substantially correct, and the discovery later on of snow-clad mountains near the Albert Nyanza, culminating in Ruwenzori, substantiated what the Greek had taught regarding the Mountains of the Moon.

The problem of the Nile was closely interwoven with that of the Kongo, the greatest mystery that still confronted geographers outside of those presented by the polar regions. The Nile question, indeed, could not be regarded as completely settled till the watershed between the two rivers had been determined. Of the Kongo basin, equal in extent to that of the Mississippi, but a mere fraction was known to the world. A boundless maze of tropical forests and rivers had thus far escaped the eye of Europeans. Geographers were not even agreed as to whether the Kongo issued from the heart of the continent or whether it was not rather in the nature of a coast river. Livingstone applied himself with heroic resolution to the task of ascertaining the parting of the waters that found their way to the Mediterranean and those that flowed toward the Atlantic. In 1867–8 he discovered the Luapula, the east head stream of the Kongo, and its two large reservoirs, Mweru and Bangweolo, and in 1871 stood on the banks of the great river that hurries past Nyangwe, but not possessed of the information that would assure him beyond doubt that it could be no other than the Kongo.

During these years wide explorations were made in Central Africa, north of the equator, by Rohlfs, Nachtigal, and Schweinfurth. Nachtigal, a worthy successor of Heinrich Barth, succeeded in making his way into Wadai, a Mohammedan state in Sudan, a goal the pursuit of which had cost the lives of two eminent explorers, Vogel (1856) and Beurmann (1863). Schweinfurth penetrated into the cannibal regions west of the equatorial Nile, and in 1871 came to the Welle, whose west course convinced him that he had traveled beyond the bounds of the Nile.

These journeys were coincident with a remarkable epoch in the geographical annals of America. The explorations of Dall revealed the extent of the Yukon; the mountain systems of the West were explored by Wheeler, Whitney, and Hayden; Powell discovered the grand cañon of the Colorado; Washburne and Hayden made known the marvels of the Yellowstone. The knowledge of British America was at this time greatly extended by the travels of Bell, Selwyn, Dawson, and others. Simultaneously with the exploration of the mountains of North America, the geological structure of the Andes was laid bare by Reiss and Stübel, who ascended the volcano of Cotopaxi to its summit.

While the rest of the world was engaged in prying open the recesses of the continents, the Russians were displaying extraordinary activity in the exploration of their vast Asiatic domain and the regions bordering on it. In the first 15 years of the reign of Alexander II., Semyenov, Valikhanov, Radlov, Ostensacken, Syevertsov, Fedtchenko, and Kaulbars assailed that mighty mountain barrier composed of the Altai, Alatau, Tian-Shan, Alai Tagh, and the Pamir, which shuts off the elevated desert region of Central Asia from the plains of western Turkestan and Siberia. During the same period Shishmarev, Mattussovski, and Pavlinov penetrated into Mongolia, and Palladius into Manchuria. The Russian advance into Central Asiatic highlands met with a prompt response from beyond the Himalayas, whence Hayward, Shaw, and Forsyth pushed into eastern Turkestan, while the pundit Nain Singh made a memorable traverse of Tibet.

When Japan and China, soon after the middle of the 19th century, opened their portals to the world, the work of exploration, previously inaugurated by dauntless missionaries and naturalists, proceeded with a new impetus. Great journeys were made in China by Blakiston, Pumpelly, Ney, Elias, Bastian, Cooper, and Richthofen, who belong to the foremost ranks of Asiatic explorers. In the decade beginning with 1861 explorations were made in the Caucasus, by Radde, in northern Arabia by Palgrave, and in Turkestan by Vámbéry and Lagrée, and Garnier traced the course of the Mekong as far up as the Chinese province of Yunnan. Contemporaneous with these travels were the remarkable journeys performed in Australia by Burke and Willis, MacKinlay, Stuart, and Forrest, whose exploits were emulated by Giles and Warburton.

The year 1871 is memorable in the history of geographical discovery for the dramatic episode of the finding of Livingstone by Stanley. The meeting by the waters of Tanganyika was followed by the exploration of the north end of the lake which was found to have no outlet in that direction. Livingstone then returned to the scene of his recent labors, the Luapula-Lualaba basin. On 1 May 1873, he expired on the shores of Lake Bangweolo, which he had discovered and which he had become convinced belonged to the Kongo system. In 1874 Cameron discovered that Lake Tanganyika was connected by an outlet, the sluggish Lukuga, with the river formed by the Lualaba and Luapula. This river (which Livingstone had reached in 1871 at Nyangwe) was found by Cameron to flow at too low a level to admit of its belonging to the Nile system. This fearless traveler was prevented by the hostility of the natives from descending the stream and verifying his belief that it was the Kongo. It was reserved for the dauntless spirit of Stanley to bring the mightiest of African rivers within the ken of mankind. In November 1876 he embarked at Nyangwe in a fleet of canoes, and performing an unprecedented voyage which twice carried him across the equator, he reached the tides of the Atlantic in August 1877. And now came the great task of exploring the Kongo tributaries, which enlisted the energies of Stanley, Capello and Ivens, Buchner, Pogge, Wissman, Grenfell, Wolf, Brückner, and Van Gèle.

While the veil was being lifted in this quarter, new light was thrown on the regions west of the Upper Nile by the travels of Junker, Casati, Gessi, and Lupton, the country between the Ukerewe and the coast was opened up by Fischer, Thomson, and Johnston, the naturalist Emil Holub traveled in the Zambesi region, and the explorations of Brazza between the Ogowe and the Kongo laid the foundations of a new French colony. Between 1878 and 1881 Serpa Pinto made his traverse of South Africa, Oskar Lenz performed a journey from Tangier to Timbuktu and thence to the Senegal, and Matteuci crossed from Egypt to the Gulf of Guinea. At this time began the extraordinary career of Emin Bey (Eduard Schnitzer), administrator, explorer, naturalist, and linguist, in the region of the equatorial Nile. This heroic commander, the peer of the great Gordon, was cut off for years from the world by the Mahdist uprising, till at last Stanley succeeded in reaching him by way of the Kongo and Aruwimi, an exploit which recalled the days of the Conquistadores. In 1887 the Rudolf lake was discovered by Teleki. In 1889 Meyer reached the summit of Kilima-Njaro.

During the years which revealed the sources of Africa's greatest rivers the exploration of the mighty tributaries of the Amazon was prosecuted by Chandless. A little later Crevaux won laurels in the same field, and to him succeeded Karl von den Steinen and Ehrenreich.

The decade which witnessed the solution of the Kongo problem, the last great mystery that had remained hanging over the equatorial zone, was marked by renewed activity in Arctic research. The passage leading north from Baffin Bay, beginning with Smith Sound, appeared to promise access to an open polar sea, the theory of whose existence had been put forth by Kane. The American expedition under Capt. Hall in 1871 proceeded up this channel, and the splendidly equipped British expedition under Sir George Nares in 1875 followed in its wake; but Kane's theory was not verified. Some of Nares' men in 1876 reached the parallel of 83° 20′, eclipsing Parry's record by more than half a degree. Lieut. Lockwood of the ill-starred Greely scientific mission in 1883 made a farther gain of four minutes. In 1873 the Austrian expedition of Weyprecht and Payer discovered Franz-Josef Land. In 1878–9 Nordenskjöld immortalized himself by accomplishing the Northeast Passage.

While Stanley and his successors were opening up the exuberant forest realm of Equatorial Africa, the arid expanse of Central Asia, stretching from the Pamir on the west to the highlands of Manchuria on the east, and embracing the desert of Gobi (Shamo), the Tarim basin, with the Takla Makan desert, and the ranges of the Tian-Shan, Kuenlun, Altyn Tagh, and Nan-Shan, was attracting the most intrepid explorers from all parts of the world. This illustrious roll includes the great Przhevalski (whose name is borne by the former town of Karakol, in Turkestan, where he died in 1888); Sosnovski, Mushketov, Kostyenko, Potanin, Regel, the pundit Krishna (who removed the long-existing doubt regarding the identity of the Sanpo and Brahmaputra), Pyevtsov, Bell, Bogdanovitch, Roborovski, Carey, the brothers Grum-Grzhimailo, Rockhill, Younghusband, Bonvalot, and Henry of Orleans. These had distinguished successors in the last decade of the century in Dutreuil de Rhins, Littledale, the young Swedish geologist Sven Hedin, Obrutchev, Futterer, Holderer, and Deasy. Among the host of ardent explorers who have traveled in China since 1875 are Sosnovski, Baber, Gill, Széchényi (son of the great Hungarian patriot, Count Stephen Széchényi), Kreitner, Easton, Hosie, Colquhoun, Henry, and Younghusband. It is only since 1880 that the geography of Korea has emerged from its obscurity.

In the last quarter of the 19th century the dimensions of the unknown in Alaska, the Northwest Territories, and Labrador were vastly reduced by the explorations of Muir, Allen, Schwatka, Dawson, Ogilvie, Russell, Low, and others. In 1888 the first crossing of Greenland's great ice cap (in its southern part) was accomplished by Nansen. In 1892 Peary and Astrup made a sledge journey of more than 1,000 miles over the northern end, and determined the extension of the island in that direction. In 1893–5 the gap between the North Pole and the highest latitude ever before reached (Lockwood's 83° 24′ in 1883) was bridged almost half over by Nansen's drift voyage and sledge journey, which carried him to the parallel of 86° 14′. This record was eclipsed in 1900 by the expedition of the Duke of Abruzzi, which reached 86° 33′. The results of these expeditions render it improbable that any extensive land mass remains undiscovered within the Arctic Circle. As the physical conditions prevailing at the North Pole cannot be materially different from those observed in the near vicinity, the reaching of the pole itself may now be regarded as a goal belonging to the realm of adventure rather than to that of scientific discovery.

In the same year in which Peary and Astrup crossed the fathomless ice cap of Greenland the gigantic glaciers of the Karakoram were ex-

plored by Sir William Martin Conway, who climbed to an elevation of about 23,000 feet, eclipsing the record of all former travelers. In 1897 Aconcagua, probably the loftiest peak of the Andes, was scaled to its summit by Zurbriggen, the Swiss guide, and Vines, the geologist of Fitzgerald's expedition, the elevation obtained for it by barometric measurement being 23,080 feet. In 1898 Conway accomplished the ascent of Illimani, one of the rivals of Aconcagua.

At the close of the 19th century the attention of the world was once more turned, after a long interval, to the Antarctic regions. The British expedition under Borchgrevink succeeded in locating the south magnetic pole, and attained to the parallel of 78° 50′, surpassing by 40′ the «farthest south» achieved by Ross in 1842. Within the Antarctic Circle remains by far the greatest unknown area on the globe. Outside of the polar realms the physical map of our planet, barring minor details, is nearly complete. When the 19th century opened, geographical science had half a world to conquer. At its close this conquest may be said to have been well-nigh achieved.

Geographical Distribution of Animals. It is a familiar fact that certain kinds of animals dwell in very limited districts, others in larger areas, perhaps throughout a whole continent; but that any considerable change in one's location on the face of the earth brings him into contact with a more or less different fauna. This is the more certain and conspicuous if a sea or mountain range or desert intervene between the two points of observation. In general it is plain that species of animals of all sorts have, as a rule, a comparatively limited habitat; genera often a more extended one; while the higher groups may have a wide or even cosmopolitan range. These areas of life for similar animals are more likely to spread in directions of latitude than of longitude, so that the northern hemisphere (*Arctagæa*) is more different faunistically on the whole from the southern one (*Notogæa*) than are, for example, Europe and the United States. The science which deals with the causes and principles of this body of facts is called Zoogeography, under which head the subject is considered in detail.

Geographical Societies are associations formed with the view of obtaining and disseminating geographical knowledge. This is attained, in the first instance, by members undertaking distant travels, at their own expense in some cases, in others assisted by the funds of the society or grants from government; and, in the second instance, by lectures delivered and works issued under the auspices of the society, or by papers read and commented on at the periodical meetings. In point of seniority the first of these associations is the Société de Géographie of Paris, founded in 1821. The German Gesellschaft für Erdkunde held its first sittings in Berlin in 1828, under the presidency of Ritter, and has counted among its members many of the most famous of modern geographers. By far the most important of these institutions, however, is the Royal Geographical Society, established in London in 1830. The principal travelers and geographers of Great Britain, or indeed of the world, are or have been connected with this society, and such names as those of Livingstone, Burton, Baker, Speke, Barth, Wallace, Cameron, Stanley, Thomson, Johnston, Bent, Curzon, Markham, Nansen, and many other well-known travelers, are to be found attached to papers in its 'Journal' (1831–80, 50 vols.) and 'Proceedings' (ceased in 1892), or in the 'Geographical Journal,' which it has issued since 1893 in monthly parts, and which includes the society's proceedings. It has a capital of $200,000, and large sums are devoted annually to aid the cause of geographical research, or as awards and recognition of services rendered to the science. The Russian Geographical Society, founded at St. Petersburg in 1845, has greatly extended our knowledge of Central Asia and Asiatic Russia. Following the lead of other nations, Italy has her Società Geografica, founded at Florence in 1867, and issuing an annual 'Bollettino.' The American Geographical Society (q.v.) was founded at New York in 1852. The Royal Scottish Geographical Society was founded in 1884. It publishes an excellent monthly magazine, and its members number between 1,500 and 1,600. The Royal Geographical Society has a membership of between 3,000 and 4,000.

Geographical Society of Baltimore, organized in 1902 for the study of geographical science. It acquired over 1,000 members during the first year of its existence. Daniel C. Gilman was the first president of the Society.

Geographical Society, The American, a society established in 1852 to encourage geographical exploration and discovery and to disseminate new geographical information. See AMERICAN GEOGRAPHICAL SOCIETY.

Geographical Society, The National, an American organization with headquarters at Washington, D. C. It was formed in 1888, and offers annual lecture courses in Washington upon popular geographical subjects. The 'National Geographic Magazine' is published monthly by the Society, which had 3,000 members in 1902.

Geographical Society of Philadelphia was organized in 1891, and in 1893 a charter was granted to the Geographical Club of Philadelphia, of which Angelo Heilprin was the first president. The present title was resumed in 1897. The Society confers annually the Elisha Kent Kane gold medal, as a reward for geographical work. In 1902 the Society had 430 members.

Geographical Society, Royal, was founded at London in 1830 to aid in scientific research in geography, and received a charter in 1859. It has published numerous papers, books, and magazines, and expended large sums of money to encourage research. See GEOGRAPHICAL SOCIETIES.

Geography, by derivation, means «description of the earth.» Humboldt's interpretation, which, beyond the gathering of data for mapping the topographical and drainage features of a region, added a study of meteorological and climatic conditions, of the character of soils, and of the distribution of life both animal and vegetable, was the first true impulse given to modern geographical research. For a comprehensive knowledge of the earth the aid of all branches of natural science is sought. Geography, while it is specifically the science or knowledge of the earth, is dealing with phenomena and study-

ing laws which belong to the universe. One of its important functions is the investigation of the reciprocal relations existing between man and his physical surroundings. The average text-books have fallen far below such a standard. Cartography and statistics form the sum and substance of these treatises. Maps constitute an essential feature of geography, but are commonly read with less intelligence than the working drawings of an engineer or architect. Lists of cities with their populations, and the names of rivers, bays, mountains and islands are of great value in the way of information, but they are of secondary importance. It concerns the student of geography less to know that New York is a city of three millions and a half of inhabitants and the greatest seaport of America than to discover the causes which have led to such growth and development. The physical or social reasons for the fixing of political boundaries are of greater interest than the mere location of or changes in the boundaries themselves. Happily a change for the better may be observed. The recognition some years ago of the scientific and practical value of geography by German scholars, and the systematic work done by them have already borne fruit. Departments of geography have been established in universities and higher institutions of learning. Geographical societies have been organized in all the leading countries of the world, and a broader interest in the subject has been aroused.

Historical.— When Columbus (q.v.) made his first voyage of discovery, popular belief maintained that the earth was flat, though the scholars of the time recognized its spherical form. The first people to add to a knowledge of distant lands were the Phœnicians. They had founded colonies as early as 1200 B.C., and exerted much influence upon the progress of civilization. Herodotus, the father of history and geography, and himself a great traveler, records a Phœnician expedition in the 7th century B.C., which, staring from the Red Sea, returned by way of the Pillars of Hercules and the Mediterranean, having circumnavigated Africa. While the story has been doubted, the incidents of the narrative give it much color of probability. Herodotus leaves an account of the conception of the earth's extent in the 4th century B.C. The scanty knowledge of the time comprised the coast regions of the Mediterranean Sea extending vaguely to the north and south, with the Atlantic Ocean and the Persian empire constituting the western and eastern boundaries. Strabo's voluminous work on geography, at the dawn of the Christian era, itself a valuable treatise, is of special importance in affording a glimpse of the efforts of earlier geographers, whose books are lost. Eratosthenes, the most remarkable of these scholars, made wonderful advances in mathematics and astronomy. He measured the obliquity of the ecliptic, described the earth as a sphere revolving on its own axis, and constructed maps with parallels of latitude and longitude. Beyond influencing the belief of a few learned contemporaries, his work was practically unavailing. Ptolemy, who lived in the 2d century A.D., was the supreme authority in astronomy and geography, not only in his own time, but during the Middle Ages. In accordance with his system, which was really a compilation of the views of earlier writers, the centre of the universe was the earth, around which the various heavenly bodies revolved. The travels of Marco Polo in the 14th century and the introduction of the mariners' compass were instrumental in changing the whole history of the human race. See EXPLORATION.

Though the knowledge of our world progressed by leaps and bounds, it is interesting to note what a large proportion of that knowledge has been the result of modern investigation. Explorers on the sea had by the end of the 18th century become familiar with the range of the ocean, the outline of the continents and many islands, but at the beginning of the 19th century four fifths of the land area were unknown. Africa, with the exception of a narrow rim of coast, was indeed a "Dark Continent." Little had been added to our knowledge of Asia since the days of Marco Polo. West of the Mississippi, North America was a *terra incognita*, and the existence of the Rocky Mountains was not suspected. Even the coast of Australia was not completely traced, and nothing had been learned of its interior. South America, which was better known than any continent except Europe, is now the least explored of all the large land masses. With the advent of the 20th century scarcely one eleventh of the land surface remains unexplored. Excepting a few interior tracts, the only portions yet unconquered lie around the North and South Poles, and these are rapidly yielding to persistent effort.

While the unity of geography should never be overlooked, the subject is commonly divided into different branches, the chief of which are mathematical, physical, and political geography.

Mathematical Geography considers the earth as a globe, with its motions and their effects, and teaches the methods of representing the whole or portions of the earth's surface on globes or maps. Observation and careful measurements have proved the earth to be spheroidal in shape. As it is flattened at the poles, it is not a perfect sphere, nor even a perfect ellipsoid, but a ball with slight irregularities of surface. Its longest diameter is 7,926.6 miles, and its shortest 7,899.6 miles. The circumference is approximately 24,000 miles.

The axis of rotation of the earth is its shortest diameter. The ends of the axis point to opposite parts of the sky, and these, called the poles of the heavens, seem to stand still while the rotation of the earth causes an apparent revolution of the sky from east to west. The whole system of determining position and direction is established by the earth's rotation. The great circle midway between the poles is the equator. Great circles extending north and south through the poles are meridian circles. Distance from the equator toward either pole is called latitude, and is measured along a meridian. Zero is at the equator, and the quarter circle north or south is divided into 90°. Small circles parallel with the equator are parallels of latitude. The equator and parallels are continually moving from west to east, and the meridians, which cross them at right angles, are carried in succession directly beneath the sun. All points on any meridian turn around the axis at the same rate, but the actual distance traversed varies from nothing at the poles to more than 1,000 miles per hour at the equator. The uniform rotation of the earth provides a

means of measuring time. The sun crosses the meridian or midday line of any place midway between the hours of rising and setting, and the interval between 2 successive noons is called a day, which is divided into 24 equal parts or hours. It is always noon on some meridian, but never on more than one at the same instant. As a complete rotation through 360° occupies 24 hours, meridians 15° apart vary one hour in local time. A person traveling toward the east completely around the world gains a day, but if he make the same journey in a westerly direction he loses a day. Distance east or west is measured on the equator or a parallel, and is called longitude. Some prime meridian, usually that of Greenwich, is the zero, and measurements are made 180° east and west. The length of a degree of latitude is a little more than 69 miles, but as the meridians converge toward the poles, degrees of longitude diminish in length as the distance from the equator increases. If the latitude and longitude are unknown, the former is determined by observing the altitude of the pole of the heavens, while the latter is obtained by comparing, with the aid of a chronometer, the exact moment at which the sun crosses the meridian with the local time of the prime meridian at the same instant. Tables, showing the relative positions of heavenly bodies for each day in the year, are calculated in advance and enable captains of vessels to find their position at sea. See EARTH.

The imaginary network of meridians and parallels can be actually drawn upon a globe. The outline of the continents and the location of places may thus be depicted with great accuracy. A map is much more convenient than a globe, but, as the surface of a sphere cannot be spread out flat, no map is ever absolutely correct. Various projections are employed to modify the distortion. Mercator's projection, and others similar in plan, are modifications of the result obtained by drawing lines from the centre of a sphere through the parallels and meridians to the surface of a cylinder touching the sphere at the equator. This style of projection is employed for navigators' charts, for while areas are distorted, a straight line drawn between any two points correctly represents direction. Several hemispherical projections upon a flat background are used. These, though approximately preserving dimensions, distort directions. For limited areas the conical projection is of value. The meridians and parallels appear as they would if traced on a transparent cone placed on the globe.

Physical Geography deals with the earth in its relation to nature. The surface is irregular, the hollows being filled with water, and the projecting parts forming the dry land. It is surrounded by a gaseous envelope. The solid portion is often called the geosphere or lithosphere; the liquid layer, the hydrosphere; and the outer mantle, the atmosphere. See AIR; ATMOSPHERE; VAPOR.

The earth is believed to be a cooling and contracting body. With a reduction in size the outer crust becomes wrinkled. The crests of these wrinkles protrude above the water, which fills the troughs. Though many changes have affected these ridges and furrows, the general arrangement of the elevated and depressed portions of the earth is believed to have been nearly permanent. Without altering the relative positions of the exposed land masses and the oceanic basins, a comparatively slight increase in the depth of the latter would cause more land to be uncovered. Or were the bed of the ocean to be raised slightly, the sea would flow over the coast regions and accessible low-lying valleys. Were the solid crust uniformly smooth, it would be completely drowned by a continuous sea about two miles in depth.

By the present arrangement, the land area constitutes 28 per cent of the surface. The ocean covers about 72 per cent, but by evaporation and condensation, some of the water is distributed over the continents to be retained in lakes or returned to the sea by rivers. Though special names are given to different portions of the ocean, it is a continuous body of water.

The surface temperature of the ocean varies with the latitude. Ice floes and icebergs form in the polar seas, while an average temperature of 80° is maintained in the tropical ocean. The daily or seasonal range is not great in any latitude. Even in the tropics heat does not extend far below the surface, and the ocean as a whole is a mass of cold water.

The amount of dissolved salts in sea water averages 3.5 per cent. The salinity is not uniform, as portions are regularly freshened. These are chiefly the belts of equatorial rains, the regions affected by the melting ice of the polar seas, and those near coasts receiving the drainage of large land areas. As heat expands sea water, thus reducing its density, it generally happens that the surface water is salter than the colder layers below. The distribution of heat and the modification of climate effected by ocean currents is of vast importance. Nearly half the sun's heat in the Torrid Zone is carried to higher latitudes. The Arctic regions receive more heat from the Gulf Stream than they do directly from the sun. The western coast of Europe from the North Cape to Gibraltar has a climate much warmer than that of the opposite coast of North America, and this work of the Gulf Stream is in a measure duplicated on the western coast of North America by the Japan current. Cold currents from the southern ocean soften the climate of the western tropical coasts of Africa and South America. If the water completely covered the earth, a double wave caused by the attraction of the moon would, on account of the earth's rotation, travel around the globe every day. This ideal arrangement of tides is not realized except in the southern ocean, and, with a general movement to the west, the tidal wave is deflected northward in the other oceans.

In determining the height of mountains or any part of the land surface, it is necessary to have some common level as a basis of comparison. For this purpose the surface of the sea has been chosen, but on account of the many movements to which the ocean is subjected and because of the attraction exerted by elevated land masses, its surface is not level, and all comparative heights are of doubtful value. Efforts have been made to determine the mean level of the whole surface. While much has yet to be accomplished in securing the requisite data, it has been quite clearly shown that such a line lies about 10,000 feet below present sea-level. The abysmal area below this line is of equal extent with the area above it. As the exposed continental area occupies 28 per cent of

the earth's surface, it follows that 22 per cent is covered by water less than 10,000 feet in depth. Quite a large part of this region slopes gently away from the coast line to a depth of 100 fathoms, forming the continental shelf. The area of this submerged shelf is very nearly the same as that of the low costal plains of which it is a continuation. Were the level of the sea to be reduced 600 feet, 10,000,000 square miles would be added to the land area, and the present exposed surface would sustain a loss somewhat greater were the sea to rise an equal amount. The proportion of land is much greater in the northern than in the southern hemisphere, and the large land masses have their greatest width in the north.

The destructive agencies are so active that in a short time all the land would disappear and be distributed over the bed of the ocean, were it not for the upheavals due to the contraction of the crust. From causes, concerning which all geologists do not agree, lines of weakness are developed, and portions of the crust are forced up into mountain ranges or broad plateaus, while other adjacent portions are depressed. The outer rocks or those forming the slopes of a young mountain range are composed of the sediment of older rocks. They are the result of processes of destruction and reconstruction, which are to be at once renewed. For no sooner are new areas exposed than the sun either by direct heat, or through the agency of wind, frost, rain, or running water, proceeds to carve the surface into new forms, carrying away the waste to cover the rocks with soil for the support of vegetation or to fill up the hollows of the sea. Rain not only attacks the rocks by force of impact and solution, but by moving broken fragments from higher to lower levels it uses them as cutting tools. The surface water and that flowing from springs form little streams, which uniting produce rivers. In its upper course, which is the steepest, the work of a stream is purely destructive. It is cutting a gorge or valley in the high land. As the slope becomes more gradual, it is alternately depositing its load of stones and gravel or sweeping them away to some lower point. In its final stretch through a nearly level area it is building up an alluvial plain. Deltas and many interior valleys, like that of the Mississippi, are thus formed. Rivers carry away immense quantities of solid material, and are continually cutting down or extending their basins. The tendency of river work is to reduce the land to a dead level, and a subdued surface is usually an indication of old age.

Relief, or the vertical aspect of a land area, is the result of the forces of upheaval and erosion, which are continually at work. The arrangement of mountains, plateaus and valleys varies in the different continents, and upon the arrangement, climate, the possibilities of development, and the history of a country largely depend. The principal mountain ranges are, however, so disposed that all of the large drainage areas are tributary to the Atlantic Ocean or its arms. Asia, the largest continent, has the greatest average elevation and the highest point of land.

The many changes in the inorganic world profoundly affect the organic world and the distribution of life. In turn, the very processes of nature are largely influenced by living organisms. The spread of any species, animal or vegetable, is promoted or retarded by such geographical features as oceans, mountains, plains, deserts, and climate, but marine animals, by withdrawing dissolved carbonate of lime from the sea water, have constructed mountains of limestone, and vegetation retards the work of denudation, regulates rainfall and modifies the rate of evaporation. Plants alone are able to construct organic from inorganic material, and animal life is dependent directly or indirectly upon plants for food.

All plants and animals are adapted to certain environments and could not live if the essential conditions were changed, but every form of life does not of necessity reach every region suited to it. Natives of one country when carried to another frequently develop with amazing rapidity, even to the extent of crowding out indigenous species. In the tropics, the forests contain a variety of forms, and the large animals live singly or in families. In the temperate zones many plants and animals for mutual protection are gregarious. Forests often contain only one kind of tree, and the variety is never great. Grasses do not grow singly as in hot climates, but form a sod. Animals move in herds and fish in shoals.

Natural distribution has been greatly modified by man. In some regions the large land animals have been exterminated, and vast forest tracts have been removed. Domestic animals and cultivated plants have replaced the native species. Man alone of living creatures is able to rise superior to his environment, to conquer and control adverse geographical conditions. This faculty is acquired, and is the result of long development. Primitive man was undoubtedly as helpless as other animals. The same sort of barriers that retard the migration of species, have also affected the growth of nations, and no thorough conception of history, which is a record of man's development, can overlook the fundamental importance of geography. It was not until the barriers were broken down and until isolation gave way to intercourse with other peoples that civilization made safe and permanent advances.

Political Geography deals merely with the distribution of the human race in different communities, but an intelligent study of the boundaries of states involves an acquaintance with natural geographical conditions and the history of the inhabitants. It has been proposed to divide history into three periods. The first, known as the Fluvial, includes the growth of nations developing in fertile river deltas, with such scanty means of intercourse as the streams afforded. The Mesopotamian nations of Assyria and Babylon, the Egyptians, and the Hindus, are well-known examples. As the sailor became more venturesome, and skirted the shores of large inland seas, the Mediterranean period succeeded the Fluvial. Columbus and Vasco da Gama inaugurated the last, or the Oceanic period. Such a view is at least not inappropriate in tracing the development of commerce.

Commercial Geography is the most practical branch of the subject. It means a knowledge of the distribution of the world's products, of existing demands for these commodities, and satisfactory means of transportation and exchange. The Phœnicians were the first great traders. Their horizon was prac-

tically limited by the shores of the Mediterranean, although they sailed beyond its confines, and many of the goods with which their ships were laden were brought to Syria by caravans. The Phœnicians were succeeded by the Carthaginians and the Greeks, but the typical merchants of the Mediterranean class were the Venetians. Their supremacy in the world's commerce was unquestioned until, at the close of the 15th century, the Atlantic succeeded the Mediterranean as the highway of trade. The centre of the world's commerce then passed in succession from Portugal to Spain, and then on to Holland, the Hanseatic towns and London. To-day commerce is not a monopoly, but is world-wide. In volume of trade the United States is surpassed by no other nation, but competition is keen, and the successful merchant of the future must be well versed in that knowledge of which geography forms the basis.

The growth of commerce has been in direct ratio to the extent and rapidity of geographical discovery. Some of the conditions, which are favorable or unfavorable to trade, are quite obvious. An indented continental outline and navigable rivers reaching the interior are most desirable features. In these respects, Europe and North America are fortunate. Asia also is penetrated by arms of the sea, but her largest rivers, like the northern streams of North America, are practically useless, because they are tributary to an inhospitable frozen sea. Africa has no breaks in its contour, and its rivers reach the sea by dropping from a plateau. Though lying next to Europe, it baffled both the curiosity and the greed of her adventurers until the latter half of the 19th century. South America is not wanting in inlets, and her river systems are remarkable, yet very little is known of the interior. It becomes evident that latitude is an important factor in the case of both Africa and South America. The torrid heat, the burning desert, and the deadly fever were obstacles which the African explorer dreaded. The stagnation of South America is also explained when its tropical position is considered. Aside from topography and climate, the character of the inhabitants has much to do with the success of commercial intercourse.

Commerce has expanded because man has been able to meet and to overcome natural obstacles. He has to a great extent eliminated time and distance, by cutting canals through isthmuses, by connecting the shores of the oceans by continental railroads, by the substitution of steam vessels for those propelled by the wind, and by girdling the globe with the telegraph. He has modified climate both as to rainfall and healthfulness by the planting or removal of trees, and by drainage of the ground. By irrigation, he has made the arid waste productive and fruitful. At the beginning of the 19th century, the merchant was obliged to visit the region in which he desired to purchase his commodities, and to carry with him the money for payment. Now, by the aid of a cosmopolitan system of credit, he may within a few hours buy in one part of the globe and sell in another without leaving his office.

F. B. Greene, A.M.,
Secretary, Geographical Society of Philadelphia.

Geolog'ical Society of America, an association of geologists organized in 1888. It was the outgrowth of the geological section of the American Association for the Advancement of Science. The society has a restricted membership of 300. A quarterly bulletin is issued under its auspices.

Geological Survey, United States, a bureau of the Interior Deparment created for the purpose of preparing a map of the United States, classifying the public lands, examining the geological structure, mineral resources, and the products of the country. To these duties have since been added those of investigating the extent to which the arid lands of the West can be redeemed by irrigation, segregating the irrigable from the non-irrigable lands, and the selection of sites for reservoirs and canals for the purposes of irrigation. The maps made by the Geological Survey are all on a large scale, and have a degree of accuracy and a minuteness in detail incomparably greater than ordinary maps. The smallest scale is 1-250,000, or about 4 miles to the inch, and this scale has been employed for regions of the West which are thinly settled, and where the topography is mountainous. But it has been superseded by scales of 2 miles and 1 mile to the inch, the latter for populous regions with slightly or moderately diversified topography, like Massachusetts and New Jersey. The maps are engraved on sheets which, with the 4-mile scale, embrace 1° of latitude and 1° of longitude. The 2-mile maps embrace tracts of half the above linear or one fourth the areal dimensions; the 1-mile maps embrace one fourth of the above linear and one sixteenth the areal dimensions. The topography is represented by «contours» or «grade curves»; that is, by lines of equal altitude above the sea. The contour intervals are uniform for each sheet, but vary in different sheets according to the character of the country. In some tracts the contour intervals represent a difference of elevation of 200 feet, these being in very mountainous countries, while in flat countries and on large-scale sheets they may be as small as 20 feet. The general construction and methods of all maps are, however, the same.

There are three principal branches of the geological survey: (1) Geology proper; (2) topography; (3) irrigation surveys. The geological branch investigates the stratigraphy, the geological structure and history, the lithology, mineralogy, and palæontology, the ores and mines, and in general the natural economics, resources, and physical geography of the country. The topographic branch prepares the maps; the irrigation branch investigates the possibilities of irrigation and selects the irrigable lands and sites available for reservoirs and canals. The work of the topographic branch is the basis of the work of the other two, and all the results of the latter are projected on the maps. The publications of the survey are: (1) the annual report of the director, which, besides the administrative report, contains memoirs on geologic subjects by members of the survey, and is distributed according to the regulations of the Interior Department; (2) monographs on the leading subjects of special investigation by the geologists; (3) bulletins on more limited special subjects of research; (4) an annual volume of mineral statistics. The last three are distributed gratuitously only to designated libraries and to learned

corporate societies, which send their own publications in exchange. Otherwise they are sold by the director and the money deposited in the treasury. See GEOLOGY; IRRIGATION; TOPOGRAPHY.

Geology is the science of the Earth's history. In common with myths of creation that appear in the folk-lore and religions of all peoples, geology recognizes the essential fact of changes which make up a history; but it differs from the myths in being well-ordered knowledge based on observation, in interpreting natural phenomena according to the laws of the material world, and in seeking causes among the forces of the physical universe. Guesses at the beginning or the end are not part of the science, which deals only with those eras that are recorded in the rocks.

Geology is a very comprehensive science, embracing some knowledge from each of the chief natural sciences. The Earth, a planet, may be studied as a member of the solar system and in comparison with stars; and in so far geology joins astronomy. The Earth is composed of elements, associating and combining according to the laws governing physical and chemical activity; thus geology includes physics and chemistry as applied to rocks, seas, and air. The Earth has been and is the home of multitudes of living beings, whose development has been conditioned by her changes and is part of her history; organic evolution, as studied through comparative botany and zoology, is, therefore, part of geology. A great geologist has defined geology as astronomy, physics, chemistry, and biology applied to the Earth.

Aims of Geology.— The aims of geologic research may be classed as three: (1) To discover the principles, the forces, and the processes of the Earth's development; (2) to trace the history of the physical world and of its organic inhabitants; (3) to advance the exploitation of natural resources for the benefit of mankind. Those views which are now current and which represent the present advancement of the science are briefly suggested in the following paragraphs, but for a more complete treatment the reader must be referred to the books and articles mentioned in the bibliography.

A Fundamental Principle.— The causes which are now effective in producing changes in the Earth have been in operation throughout all known eras of her history, and the past is to be interpreted in the light of the present. This general principle applies to all departments of the science, and is the foundation upon which all knowledge of the past is built up. If the substance of the Earth ever formed part of a nebula, it condensed according to causes now operating in nebulæ. If it was once a molten globe, it cooled and solidified as a molten globe now would. Upon the cool Earth, rains have ever fallen, streams have always flowed, seas have been gathered into basins about lands; and the processes now active on the continents, in the oceans, and within the rock mass have been active continuously, but in greater or less degree.

The intensity of geologic processes is unequal at the present time in different parts of the world, and during past eras has varied from age to age for each and every zone. The most familiar process, that of erosion, which comprises all the chemical and physical effects of the atmosphere upon land surfaces, produces very different results in lowlands and in highlands, in humid regions and in deserts, in the tropics and beneath the pole star; and during the past it has varied in the nature and intensity of its activity, as the governing conditions were more or less favorable. In these respects erosion may be considered as an illustration of the variability of other processes, all acting under immutable laws.

Geologic Forces.— The natural forces which are involved in geologic processes are: (1) Radiant energy of the sun, namely, light and external heat; (2) gravitation, both terrestrial and general; (3) chemical energy; and (4) the vital force.

Summary of Effects.— It may promote a clearer understanding of the operation of these forces to give some illustrations of their effects, before making a fuller statement of the processes of geologic change. Sunlight and heat directly act on rocks in deserts, where they are unhindered by vegetation and moisture. The brilliant glowing days and the radiantly clear nights result in changes of temperature which cause rocks to expand and contract and in consequence to crumble. The sands of Sahara are in part grains thus broken from granite. Less direct, but more widely effective, is the action of the sun through the agencies of the atmosphere, the winds, snows, frost, rains, and running streams, all of which are started and kept in motion by the sun. In life also the sun's energy is manifest.

Gravitation, as it is expressed in the force by which all things are attracted toward the Earth's centre, is familiar to us. Winds are influenced by it, rains obey it, and streams flow in accordance with the laws of its attraction. Thus gravitation and sun force cooperate in the movements of the atmosphere. Gravitation holds the oceans in their beds and the firm Earth to its form. It is the cause of pressure within the Earth, and immediately or remotely of the Earth's internal heat. The manifestations of pressure and heat are therefore attributable to it, and these include a great range of phenomena.

Chemical energy, which controls combinations of elements, and of which we avail ourselves in manifold ways, governs the constitution of minerals, the composition of the air, and that of the sea. It is effective when rocks, like an iron bar, rust at the surface of the Earth, as it is also when they change in structure and recrystallize within the Earth. All ores are chemical compounds and owe their concentration in valuable ore bodies to chemical reactions.

The vital force has animated myriads of creatures, which have built their shells or skeletons, each according to his kind, and left them as grains in great rock masses. Strata many hundreds of feet thick and many thousands of square miles in extent are composed of such remains, which thus form stupendous monuments to the activity of the vital force. But this is not all. Living creatures are liable to change according to environment, and obey a great law of adaptation and progress, the law of evolution. They have, therefore, changed as the conditions of life have changed; they have

evolved from lowest to higher forms, and are evolving. Finding their remains in strata according to a definite sequence, we are able for that place to trace the progress of evolution; and comparing stages of evolution as discovered in strata in different provinces or continents, we can ascertain in how far the succession of events affecting life was the same or was different, in Europe, for example, and America. Though differences are discovered, likenesses are surprisingly general and close, and it is believed that the parallel developments of life in different continents have occurred nearly simultaneously, age for age. Thus the time scale of geologic history is based on the evolution of living forms through vital force.

Geologic Processes.— The forces which have been described are active, and long have been, in three realms — in the atmosphere, in the seas, and in the solid rocks. They interact in each realm, and in each give rise to a group of characteristic phenomena. Thus there is an interaction or process which goes on in and beneath the atmosphere, where air and moisture affect the surface of the land, and which is called *erosion.* A second process is active in lakes and seas, in and beneath the waters; it is called *sedimentation.* And a third is that which is manifested in the movement and distortion of rock masses, and which is known as *deformation.*

Erosion.— The process of erosion may be briefly described as the process of land sculpture, the effects being observed in the forms of plateaus, mountains, hills, slopes, valleys, and plains. The forces involved have already been stated as sunlight, sunheat, chemical energy, and gravitation. The process involves several distinct sub-processes, which are broadly classified under the four heads of weathering, transportation, corrasion, and aggradation. The active agents by which the forces are applied are, primarily, the air and water in its various forms, and, secondarily, vegetation and other organisms, with their products of decay. The materials affected are rocks, and these, being aggregates of chemical compounds more or less compactly bound together, differ greatly in the degree of resistance which they offer to the same activities. Limestone, for example, being readily soluble in water containing carbonic acid, occasions valleys in a region of vegetation and moist climate, whereas sandstone maintains ridges. In an arid district these relations may be reversed.

Taking up the sub-processes of erosion we may briefly describe them, considering that of weathering first. Changes of temperature, such as ensue when brilliant sunlight is followed by clear nights, occasion sufficient change of volume in rocks to cause them to crack and shatter, as has been stated. The expansion of water in freezing widens crevices. Chemical changes in rocks are brought about at and near the surface of the ground, chiefly through water, the common solvent, which becomes particularly efficient when it contains carbonic acid or other organic acids resulting from decay. With many minerals water forms a chemical combination by which they become hydrated, as it is called, and their volume is thereby increased. Feldspar, a constituent of many crystalline rocks, is especially liable to this change, and the force of expansion due to the chemical combination is sufficient to dislocate and loosen the bonds that hold the grains together. Consequently, such rocks crumble anad form a loosened, porous covering to the sounder rock remaining beneath. This porous material, being hydrated, is more readily attacked by carbonic acid; and soluble carbonates of iron, lime, magnesia, soda, potash, etc., are formed and taken into solution. Certain insoluble constituents (chiefly quartz, silicate of alumina, and oxide of iron), remain mixed in various proportions, and constitute what are commonly known as sand, loam, and clay. The rocks which are not usually recognized as crystalline, such as sandstone, mud rocks or shales, and limestones, are broken down, in part mechanically, through heat and frost, and in part chemically. Limestone, as already stated, is peculiarly liable to solution. Those silicious rocks known as quartz, sandstone, and quartzite are especially resistant, and where they occur in masses always maintain hills, which stand higher than the worn surface of other rocks, or where they have become broken may be carried to great distances and form beds of white and brown pebbles, so commonly found.

The sub-process *transportation* is effective in distributing the products of weathering. Gravitation is the essential force, and the mantle of soil which accumulates through the mechanical and chemical activities that have been enumerated, is moved ever downward in one way or another. On steep slopes and cliffs gravity acts simply upon any loosened block, whose diminishing support finally fails and allows it to fall. Of soil resting even on gentle slopes, a mass softened by water may creep downward, or, loosened, move in such volume and so far that we recognize it as a landslide. These, however, are minor effects. In arid regions wind, the chief carrier, moves the sands of the desert, whose billows have been likened to the sea. Greatly predominant, however, the world over, is the work of running water, which from the tiny rivulet that gathers from the rain falling on a field to the great floods of the Mississippi or Ganges, is always laden with a greater or less burden of earth held in suspension, or with substances taken from the rocks by solution. The effects of this almost universal activity are incredible. It must be credited with having changed the face of the Earth again and again in the long lapse of geologic ages, and with having swept away the greatest mountain ranges and reduced continents to flat plains.

Corrasion, the third sub-process, is the wearing of stream channels. Waters gathering on a soil-covered slope wash with them particles of sand and clay. Where they fall over any inequality, they deepen the hollow beneath it, and undermine their tiny banks. Gathering volume and velocity, they acquire force to work more vigorously, and if not checked develop deep gullies. The stream at any place in its course where it has sufficient velocity, sweeps along whatever sand and clay has been carried thus far, and scours the hard rock bottom. The effect is that of a file, and the channel is deepened. If the resistant rock is a rim underlain by softer beds, the waters dig out the channel below and form a gorge, at whose upper end is a cascade, perhaps a Niagara. They may completely file through or undermine the hard rock, and thus in time lower the level of the channel to a position determined temporarily by some

rock rim farther down the stream, and ultimately by the level of the sea. There is no limit to this activity of the stream short of that slope from sea-level on which the waters can no longer keep the channel clear of sediment.

The cut which any stream makes is narrow, and it may become a deep canyon without growing very wide; but the rocks differ very much in their capacity to maintain steep cliffs or slopes; none of them endure forever. Wherever cliff faces stand boldly up, atmospheric activities loosen and undermine each jutting point, and as each falls, exposing another, the cliff recedes. When the retreating cliff becomes a slope, branching gullies develop and grow like twigs at their heads, since not only the main stream is engaged in sinking its channel, but every tributary, including the smallest rivulets, is doing the same according to its power. Growing, branching, multiplying, they become widely effective, and in time attack the entire land surface, however extensive. Throughout the early stages of this process, while channels are narrow, slopes are steep and the surfaces of highlands are broad; the landscape is then said to be young. When the streams have carried on their work so far that valleys are wide, slopes gentle, and the highlands but narrow ridges, it is said that the topography has become mature. And when, the process continuing, the highlands lessen in altitude until they become eminences scarcely rising above the valley plains, the phase is called aged.

Aggradation is a word which may be translated as valley filling. It applies to that sub-process of erosion whose effects are seen in bottom lands and flood plains along rivers. The sand and clay which are transported by rapid streams are dropped where the current slackens, it may be at a distance from the sea and high above it, or along the lower reaches of the river. The one is but an interruption in the journey of the sediment from the heights; the latter is a more prolonged but not necessarily a final stop. The winding course of a mud-loaded stream, like that of the lower Mississippi, is caused by the shoals which form in eddies and, diverting the current, cause it to cut away the opposite bank. Thus shifting, a channel wanders widely and widens the valley. By deposits made during moderately high water a heavily loaded river also builds up its banks till they stand above the adjacent flood plain, and in time of floods it may break through them and spread a fresh deposit over great stretches of fertile plain. Every spring has its story of broken levees along the Mississippi, and that river is not peculiar in this respect. The ultimate character of all valleys, if development goes on unhindered, is that of flood plains as extensive as are the lands, and valleys thus become stored with alluvium, which in course of geologic changes goes to form sedimentary rocks beneath the sea.

A phase of erosion which is not included in the above statement is that carried on by the sea along the shores where it attacks the land. The power of the sea is derived chiefly from the winds, and depends upon their prevailing direction and the distance throughout which they blow across its surface. for the winds raise the waves, which gather force as the effect is continued over wide stretches, and the dash of the waves on the shore is the effective eroding activity. The land resists according to its altitude and the coherence of the rock masses, in some places developing bold headlands, and elsewhere becoming fringed by extensive beaches. The attack of the sea is delivered in a horizontal plane at and just below the water surface, and its effect, when sufficiently continued at one level, is to cut away whatever is higher, and to produce a bench, at the inner margin of which rises a cliff or slope. The material that is worn away is carried by undertow and shore currents and distributed along the coast in favorable locations to form beaches, and beneath the sea as widespread deposits. These phenomena belong to the process next to be described — that of sedimentation. The effects upon the land depend not only upon the resistance offered to the sea, but also upon the continuance of the process. If a shore has been newly established it follows all the sinuosities of the surface contour, retreating far landward in deep valleys, projecting far seaward about headlands and islands. But when the sea has cut and built at the same level during a long time, it may have carved away the headlands and extended beaches across the bays, and thus have straightened the shore line. There are, therefore, youthful shores and aged shores, as there are youthful canyons and aged valleys or plains.

Sedimentation.— Sedimentation may be described as that process which results in layers of sediment spread under water. In a special sense the name is applied to the process as carried on in lakes and seas, and to the strata which are thus produced, but in a more general sense it may include methods of deposition of material borne by streams, by ice, and by winds, and may thus cover a large part of the effects above included in the process of erosion. In this article it is used in the more special sense, sedimentary strata being considered to be lacustrine or marine in origin.

The sub-processes of sedimentation are *sorting*, *distribution*, and *deposition*. They are effected by moving waters, and thus depend upon the winds, tides, and ocean currents. All of these movements are directly or indirectly effects of gravitation, which is, therefore, the force to which sedimentation is ultimately due.

The work of waves in eroding the land was referred to in a previous paragraph. Through their constantly repeated attacks the pebbles and sands of beaches are abraded and reduced in size, and the finer is stirred up and carried away from the coarser. Every wave agitates and washes the material of a beach, and the successions of waves constitute a grinding and sorting mill of great efficiency. That material which may be moved by the onrush of the waves is swept along the beach in the direction of the prevailing winds or heaviest storms. That which is fine enough to be taken up by the undertow is carried down under the sea and distributed to a greater or less distance from the shore over the bottom. This work of the waves is exceptionally well illustrated in the beaches that fringe the Atlantic coast of the United States from Long Island to Florida, and in the mud which is deposited over the sea bottom even to a distance of 100 miles southeast of it; for this is a coast on which the waves break with great power, under the influence of the prevailing southeasterly winds, and which is composed of soft rocks that offer compara-

tively feeble resistance. It is therefore a coast of aged aspect, characterized by long, slender, wave-built beaches, and it contrasts strongly with the young rock-bound coast of Maine.

Where any great river, such as the Mississippi, brings its burden of sand and clay and delivers it to a sea in which the waves have but moderate power, as in the Gulf of Mexico, the river builds a delta, which interferes with the course of waves and currents, and is attacked by them. The form and extent of the delta are a result of the conflict between the river and the sea. The currents of the latter receive a considerable part of the river's burden directly, they may wear away other portions which the stream deposited when conditions favored, and they carry the material on to some place where it settles. Thus the South Atlantic ocean current circulates into and around the Gulf of Mexico from south to north and east, and receiving much clay and sand from the rivers whose mouths it passes, deposits it in eddies along the coast of Alabama and Florida; another part is swept on through the Straits of Florida, where the constricted Gulf stream flows swiftly, and is carried out to form a great bank where the Atlantic deepens north of the Bahama Islands.

Another kind of sediment, consisting chiefly of carbonate of lime, is derived from marine waters through chemical or organic agencies. Lime is known to be readily soluble when combined as a bicarbonate, and to be relatively insoluble as a monocarbonate. It enters into solution as the former, and is deposited in the form of the latter as a calcareous mud. The chemical and organic conditions which govern this process are not thoroughly understood. It is known that under some circumstances the change from bicarbonate to monocarbonate may occur through chemical agencies alone, and that in other cases it is carried out through the agency of organisms which live in the sea. Whatever the process, the result is the formation of vast accumulations of calcareous mud, which are chiefly of marine origin and distribution. The South Atlantic ocean current again affords an example; it sweeps through the Caribbean, bearing a multitude of marine organisms, many of which secrete calcareous parts from the water, and, dying, leave their shells to sink to the bottom. From lands composed largely of limestone flow hard waters that may throw down a limy mud, as is the case in the Everglades of Florida; and this also becomes sediment, which the current sweeps on with the organic remains and with the delta silts of the great rivers. The result is the deposit now forming in every deep hollow of the Caribbean, of the Gulf, and along the Atlantic slope of North America.

In the aspects of the coast of North and South America, from Newfoundland to Brazil, are comprised illustrations of most of the processes of marine sedimentation. There is the coast of Maine, through whose deep embayments sweep swift tidal currents, and onto whose shores play powerful waves, grinding and distributing chiefly coarse pebbles and sand. There is the coast of Long Island, New Jersey, and the Carolinas, whose beaches of clean, white, sorted sand stretch for miles, shutting in the estuaries into which the small rivers deliver their sediment, and enclosing the land within a wave-built barrier. Outside, beneath the shallow ocean, reaches a broad flat, which extends out to the margin of the continent, and on this is spread a small amount of mud, sorted from the sands brought by the undertow and distributed by tidal currents. In the Gulf of Mexico and the Caribbean are found, on a large scale, the conditions of delta building and of marine distribution of fine mechanical and organic sediments. Chiefly by processes such as these the sedimentary rocks have been formed throughout geologic ages.

Sedimentary deposits in estuaries and lakes are similar in many respects to those of seas, but as waves are less effective in these smaller water bodies, the sorting is less complete; shore currents are also less active, and materials are carried to less distance from their source; and that which is swept out from shore is usually fine silt only. Lake deposits are closely related to river deposits, especially in regions where torrential streams sweep detritus from hills far out onto plains and into the margins of lakes; and there are vast accumulations, as in the western United States, of which it is not yet surely known to what extent they are lacustrine or how much is fluviatile.

Chemical deposits may be formed in seas or lakes whenever peculiar conditions favor the separation of a substance held in solution. The commonly accepted view is that the substance must be present in amount sufficient to form a saturated solution, so that it is thrown down by evaporation. Such is the case with enclosed lakes having no outlet, like Great Salt Lake. But there are other circumstances, as when carbonate of lime is deposited from spring waters or from ocean waters without organic agency, where saturation is not the condition, yet the substance separates. Waters circulating in a nearly enclosed sea, like the Mediterranean, and subject, as it is, to excessive evaporation, may reach a condition of concentration short of saturation, yet adequate to cause precipitation; mechanical agitation, as that of the waves, may suffice to dissociate a loosely united compound like bicarbonate of lime, and thus to precipitate the monocarbonate (the exact chemical conditions are open to discussion and to experiment); but great bodies of chemical sediments exist, and among them carbonate of lime or limestone, sulphate of lime, or gypsum, and rock salt are the chief ones.

Deformation.— In geology the verb to deform is used in its exact sense — to change form — and not with the more commonly recognized meaning — to put out of shape or disfigure. The geologic process of deformation is therefore one of change of form, and may involve altering by pressure the shape of a stone, a bed or body of rock, a mountain mass, a continent, an ocean basin, or of the whole earth. It is a universal process, which has been effective throughout all time, though not always equally so. The earthquake and the volcano are effects of very local deformation, with intense activity and under special conditions; but the process is far more general than are earthquakes or volcanoes.

Terra firma — the firm earth — appears to be a rigid, unyielding sphere only because we are able to observe but small areas, and these for but brief times. The rounded form, flattened at the poles, is determined by the balance of

gravitation with the centrifugal force due to rotation on an axis. Were the attraction of gravitation more or less, the form would still be round, but would differ from the present; and so also, if the rate of rotation were to change so that a day were longer or shorter. This is so not because the earth is soft inside, but because it is so large a mass. The effect of mass may be seen in drops of mercury on a glass plate; tiny ones are nearly perfect spheres, larger ones are much flattened. If the earth were a solid sphere of granite, and could be supported at rest on a pedestal, it would flatten down to a thin sheet.

The rounded form of the whole earth being an effect of balancing forces, we may inquire what features of the surface are, similarly, effects of equilibrium. Are the ocean bottoms underlain by heavier material than that of the continents? And is that the reason why they have sunk so low in balance with the high-standing lands? Balance water and oil in a U-shaped glass tube, and this idea of the heavier ocean beds and lighter continents may become clearer. It is that which is now most commonly accepted as the probable explanation of the extensive inequalities of the earth's surface. Yet it has also been made evident that the earth is on the whole a rigid body; one line of reasoning being that if it were not there must be tides in the land as there are in the ocean, yet observations with delicate instruments have failed to detect land tides; another that earthquake shocks travel through the spheroid at a rate at which only a highly rigid substance could transmit them. This rigidity is conceived to be an effect of pressure which is due to weight of all the mass tending toward the centre. We have seen that the ocean basins are believed to crowd heavily downward, and to hold higher the lighter continents, so that the measure of the rigidity (which is called viscosity or resistance to change of form) is less than the weight of masses beneath ocean basins; but it is obvious that the viscosity is sufficient to sustain large high masses, probably those of mountains, not balanced by masses in lower positions. Time is an important element in these problems, the earth yielding to a sufficient pressure, as tar yields, slowly.

This sphere, whose mass is yielding, yet up to certain limits firm, is stored with energy in the form of internal heat, and is subjected to strains due to external attractions, to cooling, and to the gradual effects of erosion and sedimentation, removing mountains and other elevated masses from their positions on the continents to zones of deposit beneath the margins of the seas. The equilibrium is, therefore, liable to disturbance, which is expressed in movements of one sort or another. Whatever the nature of these movements, they all come within the process of deformation. Gravitation is the ultimate cause, but the immediate causes in any particular case may be obscure, and the search for them includes the most difficult problems of modern geology. Deformation is, therefore, better known by its effects, and through those it must be described.

Turning first to those evidences of movement within rock masses, the more obvious ones are found in forms which we know have been broken or stretched. Pebbles which have been cracked and separated while yet firmly embedded in the rock are not of uncommon occurrence, and there are those which have been pressed out, as one might a ball of wax, until they form long, thin, flattened lenses. Fossil shells whose original forms can be accurately determined are found similarly broken apart or stretched while yet embedded in the matrix of limestone or shale.

Again, rocks whose original character may have been massive or bedded are found to have recrystallized and to have assumed a lamellar structure, like that of a pack of cards. This occurs through a movement which is very like that of cards pressed between the palms and slipped one on the other. Such movements occur on a grand scale at depths beneath the surface of two miles or more and throughout masses of rock which are cubic miles in volume.

Again, it is known that many rocks, such as sandstones and limestones, were originally spread in flat sheets of great extent, as compared with their thickness, even though the latter may amount to several thousand feet. These sheets may be found to be flexed in a series of parallel folds, forming alternating troughs and arches, to be crumpled as though pressed from several directions at once, and to be dislocated and thrust over one part upon another. The compression involved in such folding amounts sometimes to a very notable shortening of an arc of the earth's crust. It is estimated, for example, that in eastern North America the space between the Cumberland plateau on the west and the Blue Ridge on the east, corresponding to the great Appalachian valley and the Alleghany ridges, has been shortened by at least 40 per cent, so that what was 100 miles across is now but 60. And, similarly, the zone of the Alps is estimated to have been shortened by compression by an amount of 74 miles.

Less obvious, but not less certainly effective on a grand scale, are the vertical movements by which ocean basins are deepened, while continents are left standing higher, and mountain systems are perhaps actually elevated in continental areas. The history of continents shows that they may not have maintained from time to time the same extent of land above sea-level, but on the contrary have been submerged now here, now there, now more, now less. These changes are attributed to deformation, in consequence of which ocean basins have varied in size, so that they at one time might contain all the waters, but at other times were relatively not so deep below the continents, which were in part overflowed. The general tendency of deformation is to lessen the earth's size, to shorten the radius, and the grand movements are movements of subsidence, but minor ones, such as the growth of mountain ranges, may be in part or whole movements of uplift, that is, lengthening of the radius.

The phenomena of erosion and sedimentation which have been described afford a means of tracing movements of subsidence and of relative uplift, not only in the present age, but through all the ages of which the sedimentary rocks yield records. As is explained more fully in a succeeding paragraph on the relations of geologic processes, erosion, the process of leveling down altitudes, must come to an end unless renewed by relative uplift. The successions of sedimentary rocks which may be observed in many parts of the world show that everywhere

erosion has been at times active, and at other times inactive for lack of the essential condition of elevated lands, and therefore that there have been similar alternations of epochs of relative uplift, which set in motion the activities of erosion, and epochs of constant level, which allowed that process to run down.

Thus from many points of view there are geological phenomena which show that the process of deformation has been of world-wide occurrence, and that it has been more or less effective from time to time during all recognized geologic ages.

Relations of the Geologic Processes.— We have enumerated three geologic processes — erosion, sedimentation, and deformation — in the order in which they are most easily recognized. Erosion goes on daily and before our eyes, and the phenomena which result from it are familiar. Sedimentation is so linked with erosion, and so closely related to the nature of our shores, that many of its phenomena are as easily recognized. Deformation alone is somewhat difficult to grasp; yet if we enumerate the processes in the order of their natural sequence, we must begin with deformation, for it is the initial process, from which the others result. Were the earth a perfectly smooth sphere the waters would be spread over it, erosion would fail for lack of land surface, and there would be no sediments available for the process of sedimentation. Only when, through deformation, the ocean basins should originate, could lands emerge. Even then, if those lands retained their smooth, flat form near sea-level, the opportunity of erosion would be very limited, and the amount of sediment supplied very scanty. Not until lands attained notable altitude above sea-level could the processes of weathering and of transportation deeply affect rock masses and convey any considerable volume of sediment to the sea. Only then could sedimentary rocks accumulate in large volume or of great extent.

Again, although there were elevated lands, the process of erosion tended constantly to reduce their altitude, and thus ever to lessen its own opportunity. If the altitude once established by deformation had not been renewed by subsidence and relative uplift, it must constantly decrease until the mountains had become worn to low hills, and in the lapse of ages to plains. This, indeed, has repeatedly occurred; the continents have seen one generation of mountains succeed another and each one waste away to lowlands. Deformation, therefore, is essential to the renewal of erosion.

And still again, if there be a basin occupied by a sea and so situated as to receive sediment from the land, that basin may in time be filled and its area added to the land, unless, through subsidence of the bottom, its depth be constantly increased. There was, for example, at one time, in the eastern United States, the basin of a shallow bay of the great interior sea which covered part of North America in the Devonian Age. In that shallow basin sediment 10,000 feet deep accumulated, and the ripple marks which occur on the surfaces of the rocks from the bottom to the top of that great thickness, show that it was ever near sea-level. That it could so gather, the bottom must have sunk about as fast as rivers from the adjacent land poured in the mud.

The three processes, therefore, are related to one another in a natural sequence, deformation being the initiative process, erosion the destructive process, and sedimentation the reconstructive process.

CLASSES OF ROCKS.

In General.— Although rocks are of many kinds, which may often be distinguished by the aid of special knowledge only, yet there are four great classes of rocks, which are easily recognized as a rule. Each class comprises those kinds which result from a distinct process, the classification being according to conditions of genesis. One class is due to deformation, one to erosion, and one to sedimentation; and the fourth may be the product of deformation alone or of deformation acting after either of the other two processes. The classes are: (1) igneous; (2) surficial; (3) sedimentary; and (4) metamorphic rocks. Rocks which are thus classified include not only the compact firm substances commonly called rocks, but also beds of ash, gravel, sand, or clay, of loose and incoherent texture. A rock, geologically speaking, is any aggregate of one or more mineral substances.

Igneous Rocks.— Igneous rocks are those whose constituent minerals crystallize from a highly heated condition. They were the earliest rocks, and have developed within the earth's mass at all times down to the present. Their initial condition is commonly described as molten, but only because that is the familiar condition of lavas, a well-known class of igneous rocks. When deeply buried within the earth, they are hot, but may be restrained by pressure from melting, water and gases are mingled with the other constituents, and the condition is probably one of potential fusion and solution. When fusion occurs, either through rise of temperature or lessening pressure, the molten mass behaves like a confined liquid, and pressing into any planes of weakness separates adjoining rock masses. Moving in the direction of least resistance, it rises toward the surface, which it may or may not reach. In the former case volcanic phenomena ensue, and the rocks are said to be extrusive. In the latter case the igneous mass cools and remains buried, and in course of time may be exposed through the process of erosion. It then exhibits the characteristic relations which it has assumed through being pressed in among masses of older rocks, and is called intrusive. The chemical and physical conditions of a magma, as the material of an igneous rock before crystallization is called, are not well understood. From one and the same magma different minerals crystallize out at different pressures and temperatures, and as pressure and temperature vary greatly in the ascent of the magma from deep within the earth to the surface, various kinds of igneous rocks may be formed at different stages of the journey. Thus it is possible to have a continuous series ranging from superficial extrusives down to deep-seated intrusives. The lavas and ash rocks may be taken as the types of the former, and granite as the type of the latter. Within the magma, prior to crystallization, chemical changes appear to go on, and it is observed that a sequence of eruptions in one and the same volcanic region, and presumably from the same magma, may consist of

successively varying rocks. One of the purposes of the study of igneous rocks through the methods of petrography, is to ascertain the phenomena of chemical and physical change which magmas undergo, and so to approach the problem of the chemistry and physics of the earth's interior.

Surficial Rocks.— Surficial rocks are products of erosion. Their constituents result from the decomposition of igneous or sedimentary rocks, and the surficial rock masses are formed in various ways, according to the agent by which they are transported to a place of deposit — wind, water, or ice. In composition they differ most markedly from the igneous rocks in that the elements which form soluble compounds, such as the alkaline earths, lime, magnesia, and iron, are removed in solution. Surficial rocks, therefore, consist to a large extent of the insoluble constituents, quartz, silicate of alumina, and oxide of iron. These occur in mixtures, which constitute gravel, sands, clays, and loams of various kinds.

Surficial rocks laid down by water are chiefly river deposits, and come under the general name of alluvium. They are familiar to every one in the bottom lands of streams large or small. Surficial rocks which are spread by wind are little known in districts of even moderate rainfall and vegetation, but in arid regions where dust, resulting from the disintegration of rocks through heating and chilling, is unprotected, they become important. They are exemplified by the sands of the desert. Again, upon the seashore, the effect of winds may be observed in sand dunes; and under special conditions (probably when through the action of glaciers great quantities of finely ground rock meal were provided where streams issued from the ice), the wind has spread over vast areas a sheet of fine dust, which forms the fertile soil of areas of the western plains of North America. A similar deposit of wide distribution occurs in the valleys of China. The peculiarly fine and homogeneous clay has been called loess, and there has been much discussion as to the relations which wind and water have borne in transporting it.

Surficial rocks laid down by ice are broadly classified into those which are produced by ice alone, those which are the product of ice and water together, and those which are produced by waters flowing from the ice. In general they are distinguished from sedimentary rocks chiefly by their heterogeneous composition, since through the action of glaciers in plowing and grinding the surfaces over which they move, rock fragments of various kinds and sizes become mixed, whereas the effect of water is to sort rock debris in distributing it.

Sedimentary Rocks.— Sedimentary rocks are those which are deposited beneath bodies of water which are either still or moving with moderate currents, such as affect lakes and seas. They are laid down in characteristically bedded deposits called strata, which may generally be distinguished from all other forms of rock masses, though sometimes the sediments of a lake or estuary so closely resemble those of a river that no distinction is possible. Along this line sedimentary and surficial rocks grade one into the other. The method of formation of sedimentary rocks has already been described in treating of the process of sedimentation, to which the reader is referred.

Metamorphic Rocks.— The word metamorphic means altered, and in its largest sense, when applied to rocks, would cover all those which are not in the original igneous condition. But it has come to have a narrower meaning, and usually designates a class derived from igneous or sedimentary rocks through the action of heat and moisture and pressure, usually at some depth beneath the earth's surface. That igneous masses which have cooled as intrusives beneath the surface should be subjected to such alteration is easily understood. Sedimentary rocks though formed at the surface may, through the processes of deformation and sedimentation, becomes so deeply buried as to be subject to the same influences. In any case, the process is one of recrystallization under special conditions of pressure, and often of slow movement, and the result is that the rock assumes a more or less crystalline texture, and frequently a thinly laminated structure described by the word schist. Metamorphic rocks are of various kinds, according to the material from which they are derived and according to the degree of metamorphism, which may range from a scarcely perceptible alteration of the original rock to such complete recomposition and rearrangement as to totally obscure the original character.

THE CRUST AND THE INTERIOR.

Some Physical Considerations.— The cooling globe, of which the interior is still very hot, was until recently universally considered to consist of a hard crust over a molten liquid interior, and this view still prevails generally among well-informed people. It is not, however, that which is held by students of the physics of the earth.

It is a general law that, within certain limits, a heated substance may be restrained from melting if confined under sufficient pressure. Pressures within the earth are an effect of gravitation, all substances pressing inward toward the centre, according to their weight. The results are given in the following table, and may be seen to be enormous.

VARIATION OF TERRESTRIAL DENSITY, GRAVITY, AND PRESSURE ACCORDING TO THE LAPLACIAN LAW.
[By R. S. Woodward, 1890.]

Depth in miles	Density	Acceleration of gravity	Pressure in atmosphere	Pressure in pounds per square inch
0	2.75	1.0000g	1	15
1	....	....	400	6,000
2	....	....	800	12,000
3	....	....	1,210	18,150
4	....	....	1,620	24,300
5	2.76	1.0006g	2,020	30,300
10	2.78	1.0012g	4,200	63,000
15	2.79	1.0018g	6,390	95,850
20	2.81	1.0024g	8,600	129,000
50	2.89	1.0060g	22,000	330,000
100	3.03	1.0116g	45,300	679,500
500	4.18	1.0379g	236,000	3,540,000
560	4.36	1.0389g	318,000	4,770,000
610	4.50	*a* 1.0392g	354,000	5,310,000
660	4.65	1.0389g	391,000	5,865,000
1,000	5.63	1.0225g	672,000	10,080,000
2,000	8.28	0.8312g	1,700,000	25,500,000
3,000	10.12	0.4567g	2,640,000	39,600,000
3,959	10.74	0.0000g	3,000,000	45,000,000

a This is the maximum value, and the corresponding depth, 610 miles, is the depth at which a given mass would have the greatest weight.

From these estimates it is inferred that the pressure within the earth is sufficient to restrain the mass as a whole from melting, and that a fluid globe within an external hard crust is physically impossible, in spite of the high temperature of the interior.

Under pressures which exceed their crushing strength, the condition of rocks must be one of greater density than at the surface. In fact, the earth having been measured and weighed, it is known that the density of the whole is approximately five and a half times that of water, or about twice that of the rocks occurring at the surface. Hence it is evident that the interior is much denser than the exterior, or, in other words, rocks within yield to the compression.

Direct evidence of the rigidity of the earth's mass has been found through studies of the tides and of earthquakes. Were the earth liquid it must be subject to tidal movements, as are the seas, but observations with very delicate instruments have failed to detect any such earth tides. On the other hand, earthquake shocks recorded by appropriate instruments are known to be transmitted directly through the sphere, as well as around it, and at a speed through the mass greater than that with which they pass around. This fact is taken by physicists as sufficient evidence of great elasticity of the earth's mass, which is consistent only with great rigidity. Thus along several lines of reasoning from the laws of physics, there is evidence that the earth is solid, not fluid, within; and this conclusion is sustained by the phenomena of deformation observed through the methods of geology. Movements of the earth's surface recorded in the development of continents, of lands, and of ocean basins have been so gradual that, considering the great mass of the globe, they are possible only on a rigid sphere. These considerations do not disregard the facts of igneous rocks and volcanic activity, which are, however, to be explained as intense and local results of special stresses set up through the process of deformation.

That portion of the earth's mass which is of most interest to man, and with which he is best acquainted, lies within the moderate depth of six miles from the surface. Here occur all the phenomena of mechanical and chemical change which result in mineral deposits of use and value. The relations of pressure to strength of material are of great importance, and through them the superficial crust is divided into three zones.

The uppermost is that in which all rocks are under such moderate pressures that when forced to move, in process of deformation, they break. Consequently in this uppermost zone, which has a depth of perhaps a mile, cracks and crevices are of general occurrence.

Beneath this superficial zone of fracture, but not distinctly divided from it, is another, in which weak rocks, such as the clay rocks, are constrained by pressure to maintain a coherent mass without open cracks, while other rocks of greater rigidity, such as quartzite, may still break apart. This is the zone of flow and fracture. Under such weight, beds of hard rock may be folded, as one may bend layers of wax, and folds may be pressed one over another till strata are overturned and the order of succession becomes inverted.

A third zone is known as the zone of flow. It lies at a depth of four miles and more below the surface, and is that in which no rock is capable of breaking, because the pressures exceed the crushing strength of any rock. When movement occurs, the masses change form as wax would. This zone is one in which and beneath which there can be no spaces not filled by rock materials, and beneath which, therefore, atmospheric waters cannot penetrate.

Beneath the zone of flow the materials are in that condition of heat and pressure which constitutes the state of potential fusion, referred to in describing igneous rocks; but the conditions so far exceed any which can be observed, that our apprehension of them must long remain in the state of hypothesis, rather than in that of knowledge.

The term crust may well be applied to the three zones of fracture, of flow and fracture, and of flow. The lower limit of the latter can not be defined, but within a thin film, at the most a score of miles deep, is the vast unknown interior.

Some Chemical Considerations.— Chemical reactions, involving exchanges of constituents between substances, are accompanied by changes of temperature and of volume. Burning is a reaction which gives off heat. When carbon is the substance burned, the product is carbon dioxide, CO_2; now we may heat CO_2 to a temperature at which it separates, or dissociates, into two gases (CO and O or carbon monoxide and oxygen), and in this change heat is absorbed; that is to say, in the presence of low temperature the reaction and the effects are the reverse of what they are in the presence of high temperature. If we consider the change of volume involved in different chemical reactions, we shall find those in which there is expansion, and others in which there is shrinkage. When lime is slaked, water combines with the lime and the combined volume is greater than that of the two before combination. The same reaction and result occur when moisture affects feldspar in granite, and combines with or hydrates it. The force of expansion is sufficient to burst the bonds which confine the feldspar crystal in the granite. If we heat the hydrated substance, we can drive off the water; and if the heating occurs under pressure the water is driven off at a lower temperature, because dehydration involves shrinkage, and therefore is promoted by pressure. These illustrations may serve to introduce the general law of chemical reactions as affected by heat and pressure, namely, that between two substances that reaction will tend to occur which meets least resistance or is most effectively aided by the environment.

If we consider the earth's crust as a scene of chemical changes we find that both temperature and pressure increase to a notable degree from the surface downward, and applying the above law we may expect that those reactions which involve liberation of heat and expansion of volume will tend to occur near the cool surface, whereas those resulting in absorption and contraction will be favored in the warmer zones below. The chief effects of weathering in the superficial zone of rocks are the substitution of water, oxygen, and carbonic acid for silica in combination with iron, lime, magnesia, and the

alkalies. Some insoluble oxides result, but silica and carbonates go into solution and pass downward into underlying permeable rocks, where they are deposited in great quantities. Beneath the zone of weathering there is thus a zone of cementation, in which the cavities in rocks become filled. If reactions take place the resulting minerals are those whose constitution is favored by high temperature and great pressure. Carbonates, which in combining expand and give off heat, are formed at less depths than silicates, which contract and absorb heat as they form. The zone of cementation grades downward into that of recrystallization, where chemical changes are brought about chiefly by movements within rock masses, and are altogether such as involve absorption of heat and produce heavy minerals.

If the physical and chemical conditions which have been separately suggested be associated as they are in the earth, we may state the effects in the following way:

and the frequency of overtakes. It may have been sufficient to result in general melting, but more likely was insufficient to raise the temperature of the mass to a high degree. This suggestion does not disregard the existing internal heat of the earth, but it has been shown by calculation that that temperature is adequately accounted for by gravitative concentration of the spheroid without external collision.

The earth, according to these considerations, entered upon its present phase of a solid globe with watery and airy envelopes, possibly from a previous condition characterized by somewhat higher temperature, possibly by aggregation of cold matter. When, if ever, a hot earth and a steaming atmosphere gave place to a cold earth with waters gathered in oceans (or when the growing planet had reached approximately its present mass), then began that chapter of history which may be recorded in existing rocks and which it is the object of geology to elucidate.

Zone	Depth	Physical conditions	Chemical conditions
Of fracture and weathering.	0 to 1 mile.	Many open spaces and relatively large crevices; comparatively free circulation of water.	Active oxidation, hydration, carbonation, and desilicification.
Of flow and fracture and cementation.	From near the surface to 4 miles.	Open spaces relatively small and growing smalier with greater depth, till only capillary openings remain.	Cementation by deposition of oxides, carbonates, sulphides, and silica.
Of flow and recrystallization.	3 to 6 miles.	Only capillary and subcapillary openings.	Alteration of rocks with development of heavy silicates.

GEOLOGIC HISTORY.

General Statement.— The astronomer, the geographer, and the biologist consider the earth's history from distinct points of view, the first regarding it as that of a planet, the second as that of oceans and continents, the third as that of organisms. The geologist's account comprises the later phases of astronomical history, includes all geographical changes, and furnishes the fundamental data for the understanding of organic evolution.

The astronomical history of the planet has since Kant and Laplace been based on the nebular hypothesis, according to which the solar system has resulted from the segregation of a homogeneous nebula, and the material of each planet has condensed from a gaseous condition to that which it now has. Intense heat must result from such condensation, and therefore the earth is thought to have cooled from a molten state. Mathematical tests recently appear to show that a homogeneous nebula could not condense to form a system in which the planetary masses should be distributed as they are in the solar system, and also that at the high temperature and great speed of rotation which are necessary to the hypothesis, the earth could not have held so light an element as hydrogen, which is an abundant constituent of terrestrial substances. An alternative hypothesis formulated by Chamberlain, suggests that small cold bodies, designated planetessimals, moving in a common orbit, have coalesced by overtake, rather than by opposed collision. The heat resulting from such a mode of aggregation may have been more or less, according to the size of the bodies

Permanency of Continents and Oceans.—The student of ancient terrestrial geography approaches his subject with a theory of permanent ocean basins and continents; the Indian, Atlantic, and Pacific, Eurasia, Africa, and the Americas are regarded as primeval features of the earth's surface. Yet it is known that every continental area has been submerged beneath marine waters more or less, again and again. The apparent contradiction of theory and knowledge lies in the fact that the words continent and ocean basin have a popular meaning and a technical one, which are not quite the same. In a popular sense the shore line divides the one from the other; in a technical sense a continent may (and now generally does) extend out under the shallow sea to a terraced slope that descends into the depths of the ocean basin proper. In other words, the ocean basins are too small at present to hold all the waters, which therefore overflow upon the margins of the continents. The basins, having been more or less capacious from age to age in the past, have now held, and again not held, all the waters, which accordingly have withdrawn from the lands, or have submerged them. But these changes have not affected the existence of the basins and continents as a whole.

Geologic Time.— The age of the Earth is inconceivable. This seems to be equally true whether we consider the eons which have elapsed since the planet became an individual in the solar system, or only the eras that have passed since it assumed its present physical characters as recorded in the rocks. That eminent physicist, Lord Kelvin, proceeding on the

assumption that the earth has cooled from a gaseous condition, has calculated that not more than 40,000,000 years, nor less than 20,000,000 years, have passed since condensation began. But we have already seen that the assumption is not surely correct, and geologists have uniformly contended that far more time was necessary for the events of which they observe the evidence. The estimates based on geological phenomena and comprising only the time covered by them, have rarely been less than 100,000,000 years, and larger ones are probably reasonable.

Before proceeding to state the divisions of time which geologists recognize, it is desirable to suggest the evidence upon which they base their distinctions. It is a simple principle that where sediments have been deposited, layer upon layer, the bottom strata are the oldest. And this principle underlies all determinations of relative geological age. It may be applied to any succession of rocks, however thick, which may be observed in a continuous exposure. In regions where the strata lie horizontally, such observations are limited to a few hundred feet, or at most to a few thousand. But strata are often observed to be tilted so that their edges are exposed in a horizontal surface, and there is then the possibility of examining the relations of strata many thousand feet thick.

A second principle rests upon the evidence of interruptions in the accumulation of sediments such as occur when the sea bottom is for a time elevated above the water and is exposed to the process of erosion. Features of a landscape are then cut upon the strata, and a record is made of the topographic aspects of the land. If the surface is again submerged, and stratified rocks are again laid down upon it, the evidence of interruption remains, and the two series of sedimentary rocks are said to be unconformable. It not infrequently happens that during the interval the underlying set has been deformed, has undergone more or less profound changes of character, and is evidently very much older than the overlying sequence. A great interval of time is then represented at the unconformity between the two rock masses, but the record of it can be compared only to torn or missing pages of an ancient manuscript.

Evidences of sedimentation or of erosion enable us to ascertain the succession of events in any one province, that is so far as we can trace and identify the same strata and the same unconformities, but this possibility is limited by many conditions. On comparing the sequences of strata, even of adjacent provinces, marked differences are found and the simply physical phenomena fail as a basis of correlation of events of history which occurred in separated regions.

A third principle rests upon the evolution of organisms. Late in the 18th century an English engineer, William Smith, who was in charge of a canal dug across tilted strata in southern England, observed that many of the beds contained marine shells; that certain kinds of shells occurred particularly in the lower and older beds, and other kinds in the younger and upper beds; and that these differences as to the kinds of shells were definite and constant. Hence he concluded that wherever he might find shells characteristic of a certain stratum he had a representative of that particular bed, even though he could not trace its continuity from place to place. Thus William Smith laid the foundations for one of the great generalizations of geology, which is that in sediments of each epoch of the earth's history since life began were buried the remains of creatures characteristic of that general time; and these remains becoming fossilized serve to identify the strata in which they may be found with the epoch during which the organisms lived. Hence it follows that fossils are used to compare and correlate the events of geologic history in one province with those in another province within any one continent, and also from continent to continent. But correlation even by faunas is not an accurate matching. Faunas of different provinces are rarely closely alike, their migration has been influenced by physical changes, their evolution depends upon the environment which was undergoing change and was shifting. Correlation by faunas, therefore, involves comparisons of developing migrating associations whose likenesses are derived from a more or less nearly related common stock or stocks. Like methods of correlation by physical evidence it is of highest value only within short range; but of all methods, it is that which at present must be relied on for the greatest ranges.

Great sequences of strata, each of which is characterized by peculiar associations of fossils, have been found throughout Europe, and parallel sequences have been identified throughout North America. In other continents also closely related systems of strata are known. Each great sequence thus marked by peculiar remains of life is named and is thought to correspond to a particular geologic period, although the limits of time divisions are indefinite to the extent that correlation is approximate. The errors, however, are small in comparison with the vast lapses of time represented, so that we may say with Huxley that geologic systems were relatively contemporaneous, though not absolutely so.

The recognized systems are enumerated below in the order in which they would be found in a column were they all to occur in any one province, the oldest at the bottom, the youngest at the top. Their names are taken in most instances from districts in which the strata occur typically, or from characteristics of the rocks themselves. The time division corresponding to a system is here called a period. Periods are grouped to constitute eras, and these are named according to the condition of development of the living forms, except the first, the lifeless era. Thus we have the Azoic, lifeless era, the Eozoic, dawn life era (or the Proterozoic, fore life era, or Agnotozoic, unknown life era), the Paleozoic, ancient life era, the Mesozoic, middle life era, and the Cenozoic, modern life era.

Each system is divided into series, some of which have received names that are used alike in Europe, America, and elsewhere wherever the fossils characteristic of the series are found, while others are identified by name in a particular province only. The Quaternary is divided into Pleistocene and Recent, the former term designating collectively the Glacial epochs. The Tertiary of Europe and North America includes the Eocene, Oligocene, Miocene, and Pliocene series, enumerating from earlier to later. These cover the most familiar cases of


GEOLOGICAL MAP
of the
UNITED STATES AND PART OF CANADA
Compiled by
BAILEY WILLIS
with the aid of geologists of the U.S. Geological Survey
1906
Scale
GULF OF MEXICO
JAMES BAY
LAKE SUPERIOR
NEBRASKA
COLORADO
OKLAHOMA
MISSOURI
ILLINOIS
WISCONSIN
DAKOTA
NORTH CAROLINA
GEORGIA
INDIAN TERRITORY
ARKANSAS
CENOZOIC
MESOZOIC
PALEOZOIC
PROTEROZOIC AND ARCHEAN
LATER IGNEOUS ROCKS
Eocene
Jurassic
Permian
Devonian
Silurian
Cambrian and Ordovician
Algonkian
Metamorphic Rocks

names of series in world-wide use; those names which have only provincial use are very many and their definition and correlation belong to manuals and special articles.

Eras.	World-wide systems of strata corresponding to periods of the same names, U. S. Geological Survey usage 1903.	Periods, Geikie's text-book, 1885.
Cenozoic.	Quaternary	Recent Pleistocene
	Tertiary	Pliocene Miocene Oligocene Eocene
Mesozoic.	Cretaceous	Cretaceous
	Jurassic	Jurassic
	Triassic	Triassic
Paleozoic.	Carboniferous	Permian Carboniferous
	Devonian	Devonian
	Silurian	Silurian
	Ordovician	
	Cambrian	Cambrian
Proterozoic.	Algonkian	Archean
Azoic.	Archean	

Within each series there are many minor subdivisions which represent conditions in local districts of each province, and for these again distinctly local names must be chosen. The common practice is to give to each such minor division of a rock sequence the geographic name of a place at or near which the particular formation is to be seen in typical character, and this name is applied to that formation as far as the latter can be traced continuously. There was formerly an attempt to recognize the details of geologic systems throughout wide areas, even throughout continents. The geology of North America having been studied first in a thorough manner in New York State, names which were selected from New York localities were applied to formations in distant territories. The "Potsdam sandstone" and the "Trenton limestone" are much-abused examples of this practice. But it has been found necessary to recognize the great complexity of the geologic record by giving distinctive names, and the labor of reducing the multitudinous details to that orderly historic record which they no doubt express must proceed slowly with the development of more complete knowledge of the physical and biological conditions of the past.

Aspects of Physical History.— No attempt can be made to condense an account of geologic history into these few paragraphs, but a general view of the subject may be given. We have seen, in considering geologic processes, that deformation is the initiative process, and that all other phenomena are more or less remote effects of the gravitation of the earth's mass toward its centre. Therefore the first question we may put to the historic record is: What have been the chaanges in the internal energy of the earth during recorded geologic time? The commonly accepted view that the earth has cooled from an excessively heated condition, since the formation of the oldest known rocks, is not sustained by geological evidence. It is true that the oldest rocks — those of the Archean — are predominantly igneous rocks, that is to say, they have crystallized from a molten state. There is, however, abundant evidence that the areas in which they are now observed have been very deeply denuded in process of erosion, and therefore that these ancient rocks have come to the surface from great depths, at which at the present time similar rocks are presumably quite as hot as they were. The igneous character of these ancient rocks is, therefore, entirely consistent with the hypothesis of a cool surface at the time of their crystallization. Moreover, there occur with them small but significant amounts of sedimentary rocks, which in chemical and mechanical characters resemble those of later, even of the latest, epochs, and which therefore indicate that the conditions of temperature were not markedly different from those which now exist. We may consider it improbable that the internal energy of the earth has since the beginning of the Algonkian undergone such great changes as are commonly conceived.

Again, it is frequently supposed that the earth's energy as expressed in the development of mountain ranges, was far more intense and effective in earlier geologic periods than now. But each epoch of mountain growth, and there have been many, is recorded in the sediments which resulted from erosion of the uplifted land masses, and from the volume and character of the sediments we may infer the magnitude of the uplift. Studied from this point of view, the sedimentary strata give no reason to suppose that mountains greater than those which now exist have ever diversified the surface. On the contrary, it appears that there have in the past been long ages during which no mountains developed, and that these ages alternated with epochs of shorter duration, during which mountain growth was an active phenomenon. The Algonkian period, whose duration was probably equal to that of all time since its close, may have included several such alternations of quiescence and activity. It certainly was in some districts, as in that of Lake Superior, characterized not only by vigorous but even by volcanic mountain growth. The Cambrian and Ordovician periods, on the other hand, were not thus marked, and sediments, changing as they do from the mechanical products of erosion to those of a marine origin laid down in widespread seas, indicate that the land stood long at a constant level with reference to sea, and that the elevations of an early date were later reduced to wide plains, which were submerged as they subsided. During the Silurian and Devonian there were cycles of erosion resulting from local uplifts, in alternation with epochs during which the processes were relatively at rest; but these appear to have been of shorter duration. The greater part of the Carboniferous, from its earliest epoch on toward the close, was, like the Cambrian, a time of constant level, followed by subsidence of lands and expansion of seas. The closing epoch of the Carboniferous period and of the Paleozoic era initiated an activity which continued into the Triassic and resulted in extensive lands diversified by mountain chains.

During the Jurassic and Cretaceous these were eroded to low plains, and the surfaces of the lands were widely submerged beneath the broad Cretaceous seas. The Tertiary, like the Upper Silurian and Devonian, had its minor cycles, culminating in a broader extension of the lands; and at the present time we live in an epoch of vigorous mountain growth, when the aspects of the earth are most varied and the conditions of environment and climate are most favorable to a great variety of plants and animals.

Much stress has been laid upon sedimentary rocks in the preceding brief statement, because it is through the orderly relations of stratified beds, and through the fossils which they contain, that we are able to make out something of the geologic record.. In order that the reader may gain a clearer idea of the manner of distribution of sediments following upon the great fluctuations in the distribution of lands and seas, the following maps of North America showing the geographical conditions of widely separated epochs, are herewith introduced.

Paleography is that branch of geology which deals with the geography of past times. The appended paleographic maps of North America are based on physical and faunal evidence, which is acceptable as showing the general geographic condition during a geologic age; they are not refined enough to give the geography of a particular epoch. The limits of seas and lands, even where most accurately mapped, were changing, and in no case can one of these maps represent the geography of the continent at a definite date.

FIG. 1.— Geography of North America during the early Cambrian. Preceding this stage land areas had long been extensive; following this stage they became less by general planation and submergence.

Aspects of Climatic History.— Climatic conditions of the past are known to have been variable. There are evidences of extremely luxuriant plant growth, indicative of warm and moist climates, and in alternation with these occurred ages during which chemical sediments, such as salt and gypsum, were laid down in quantities consistent only with great aridity.

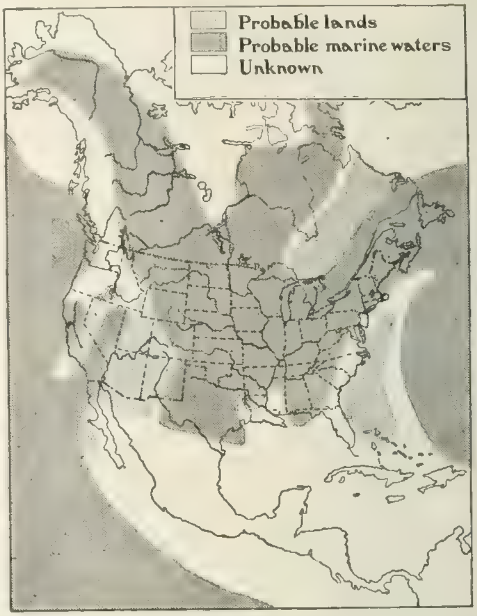


FIG. 2.— Geography of North America late in the Ordovician. About this time the continent was probably more extensively submerged than at any later epoch; extensive emergence followed.

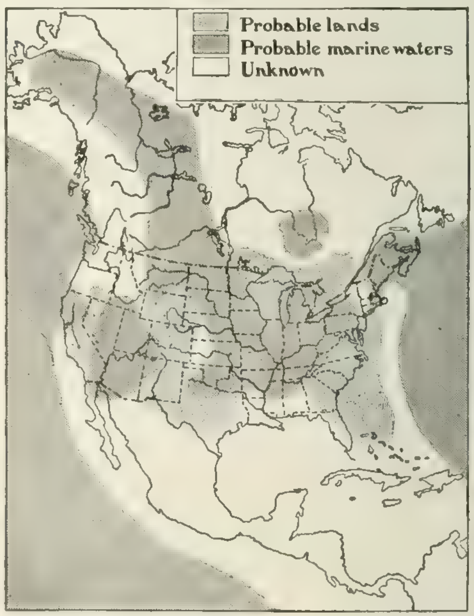


FIG. 3.— Geography of North America late in the Devonian. Preceding this stage land areas had been more extensive, particularly in the eastern United States; following this stage the seas expanded to the condition shown in the next map.

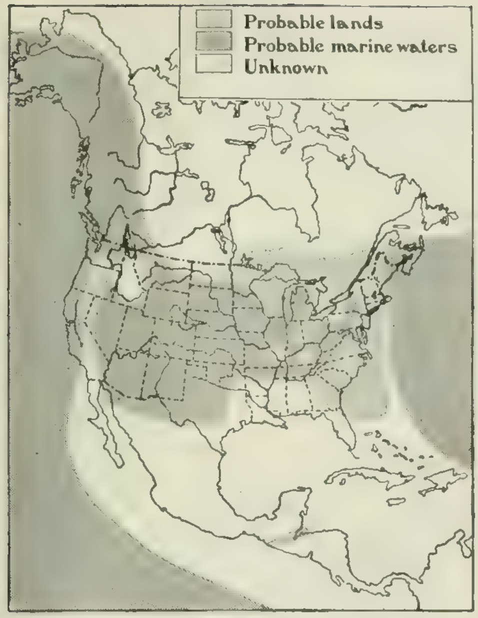


FIG. 4.— Geography of North America during the Mississippian age. At this stage the late Paleozoic seas probably had greatest extent.

Again, there are records of tropical vegetation within the present Arctic Circle, and also of a general ice mantle extending in Europe and America as far south as the fortieth parallel of latitude. Extensive glaciers occurred in Aus-

FIG. 5.— Geography of North America during the Pennsylvanian (Coal Measure) age. Preceded by more extensive seas, this stage was characterized by emerging lands. Marsh, river, and marine deposits alternate in areas shown as fresh water.

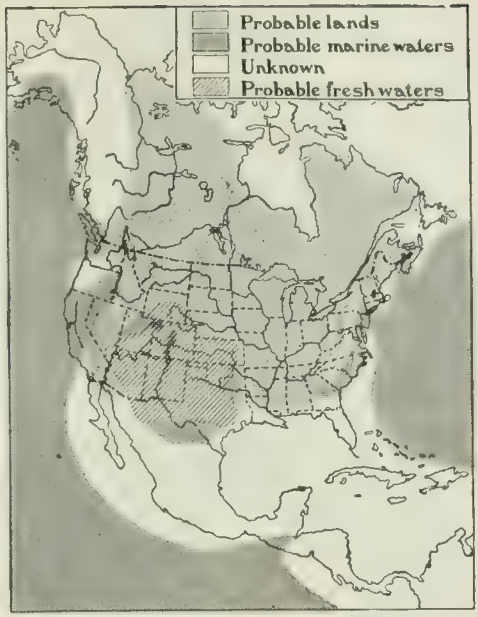


FIG. 6.— Geography of North America during the Permian and Triassic ages. This map represents the passage of the continent from Paleozoic to Mesozoic aspects. From Mississippian to Triassic time the net effect of conflicting movements was the general withdrawal of marine waters from the continent, and the later stages of that phase are here represented. Marine deposits also occur in fresh water areas.

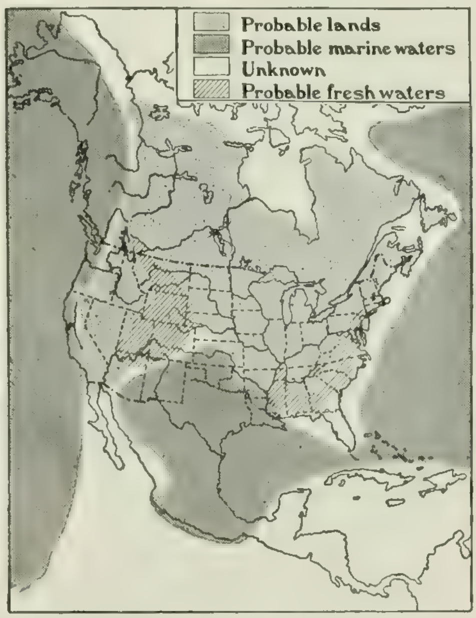


FIG. 7.— Geography of North America during the Lower Cretaceous. Preceding this stage, namely, during the early Mesozoic, land areas had been more extensive than at any time since Algonkian. This map represents the first stage of the Cretaceous submergence which increased to its maximum, see next map.

FIG. 8.— Geography of North America during the Upper Cretaceous. This map represents the culmination of the submergence which occurred during Cretaceous time.

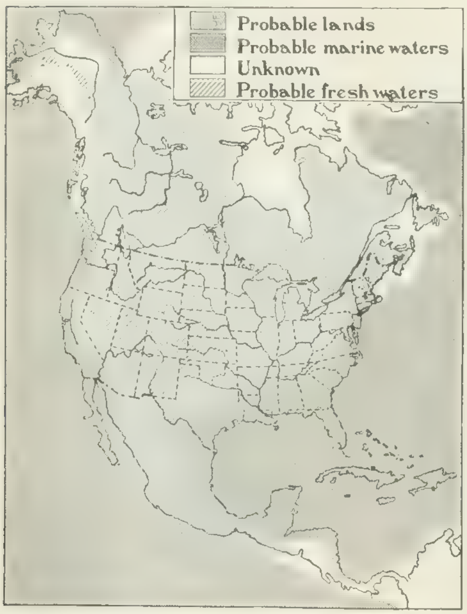


FIG. 9.— Geography of North America during the Tertiary. Accompanying the withdrawal of marine waters from the areas over which they had spread in Cretaceous time, there were effective mountain growths which continued intermittently through the Tertiary and into the Pleistocene, and which resulted in the present distribution of ranges. In the provinces of the Rocky Mountains and Great Plains river and lake deposits of unusual extent accumulated. The map is a composite picture, not one of any definite stage.

tralia and South Africa late in Carboniferous time, where but a short time previously tropical conditions had prevailed, as they do now. Various hypotheses have been framed to account for these special conditions, some of them depending upon changes of astronomical relations of the earth to the sun, others upon altitude of lands above sea, and one upon the constitution of the atmosphere. The last named appears at present to afford the most reasonable basis of explanation, though the hypothesis is by no means established as true in all its phases. It rests upon the physical and chemical properties of carbonic acid (CO_2), and upon the fact that this substance is present in our atmosphere in very small quantities. Physical researches have shown that even the small amount present has a potent influence in absorbing the heat of the sun and raising the temperature of the atmosphere. That is to say, it thickens the atmospheric blanket about the earth. A slight in-

FIG. 10.— Geography of the Pleistocene ice sheets in North America. During the Pleistocene ice sheets developed about three centres in northern Canada and with fluctuations sufficient to characterize several glacial epochs extended at their maximum to the limits shown on this map.

crease in the minute percentage present would suffice greatly to extend the climatic conditions of the temperate and tropical zones toward the north and south poles, whereas a diminution to one half of the present quantity would bring on the conditions of the glacial epoch. Carbonic acid is the most active reagent of the atmosphere entering into decomposing rock masses, and must be taken into combination in relatively great quantities during periods of active erosion. When so combined it occurs in solution in waters in the form of bicarbonates, and in large part passes to the sea. As periods of erosion are not indefinitely continued, but in course of time cease through the activity of the very agencies of erosion, that process runs down, and in time the absorption of carbonic acid becomes relatively insignificant. The

amount of carbonates conveyed to the sea may, however, by that time have been sufficient greatly to promote the activity of organic and chemical agents, through which monocarbonates are deposited, especially as limestone, and the second molecule of carbonic acid is set free. The latter is then returned to the atmosphere, which may thus become re-enriched. This idea is the central one of the carbonic acid hypothesis of climatic variation; but with it are combined many auxiliary facts and conditions which greatly strengthen it and serve to explain many of the minor cycles of variation whose record is noted in the rocks and in the life forms which they contain. The whole hypothesis rests upon the periodic activity of the earth's internal forces, already described in speaking of the growth of continents and mountain ranges; and thus climatic change is traced to deformation, the initiative process of all physical conditions of the earth.

It is estimated somewhat indefinitely that 40,000 years have passed since the climate was such that the southern part of the latest great ice sheet occupied Lake Erie and, retreating, permitted the cataract of Niagara to begin its existence at Lewiston. From that place the river has since cut back its gorge to the present site. That time, 40,000 years ago, may be regarded as the close of winter in one of the great cycles of climatic change. It would be interesting to know how long the seasons of that cycle are. Are forty thousand years a month, a springtime, or more? Do we live in the early vernal season of a great era and is the climate to grow warmer during many tens of thousands of years to come? Or is the summer of this cycle well advanced and will a glacial winter again sheathe the north temperate zone in ice?

Aspects of Organic Environment.— The evolution of organic life is properly a subject for distinct treatment, and not to be considered in this connection, except to point out the influence which changes of environment may have had. As far back as early in the Algonkian period, that is to say near the beginning of well-recognized geologic history, there were deposits of carbonates and of carbonaceous material which seemed to indicate the existence of organisms, and trails made by some low forms crawling upon soft mud are abundant in later Algonkian strata. The beginning of the Cambrian period is, however, the first time at which fossils were preserved in large numbers and of varied species. Six of the nine classes of creatures now recognized are represented in strata of that period, and the vertebrates appeared in the next. The other two classes are not of such organisms as would leave remains likely to be preserved. The variety and exuberance of life shows that evolution had been going on during long ages prior to the Cambrian, and that conditions had long been favorable for organic activity. In this connection it should be noted that during the Algonkian, so far as the record goes, land areas had been extensive and sea basins had probably been correspondingly deep and limited. During the Cambrian and succeeding Ordovician periods, occurred one of the greatest submergences not only of North America but also of Europe, and the expanses of shallow seas afforded great realms in which the conditions were favorable to life. These two periods are also characterized the world over by a predominance of deposits of limestone, which according to the atmospheric hypothesis above suggested should have resulted in warm climates appropriate to exuberant life development.

If we were to trace the great changes in living forms which occurred in passing from the Ordovician to the Devonian, from the Carboniferous to the Triassic, from the Cretaceous to the Tertiary, we should find that each accompanied and probably resulted from the great variations of habitat and of climate. Epochs during which seas were wide and temperatures high promoted development and resulted in great diversity of genera and species. Epochs during which seas were limited to deep basins afforded very narrow areas in which competition was fierce and opportunity limited, and the low temperatures resulting from erosion of extended land areas were unfavorable. It is along these lines of suggestion that the geologist is now seeking for the explanation of the stages of organic evolution and of the unequal progress which has been made from one age to another.

APPLIED GEOLOGY.

Scope of the Subject.— The scientific principles of geology relate to rocks and minerals which are useful to man and afford a means of determining their origin, their forms of occurrence and extent, and the peculiar relations of rock masses or structure which have led to concentration, notably of metallic ores. All classes of mineral products fall within the scope of applied geology. Gravels, sands, and clays of surficial deposits, massive rocks quarried for building and ornamental purposes, coals, and other bedded strata, and the ores of iron and of the precious metals, all these are products of genetic conditions which when understood afford clues that promote discovery and direct exploitation. Inasmuch as only exceptional occurrences are valuable, whereas it is generally supposed that mineral wealth is common, the service of applied geology is as frequently to prevent unprofitable operations as to aid those which may yield results. The essential knowledge belongs in part to each of the sciences of geology, mechanics, physics, and chemistry, and to be reliable should be aided by wide experience in observations underground, as well as of geological phenomena in general. The application of principles must rest upon an intelligent understanding of the conditions of formation of a rock mass or deposit, and accordingly economic minerals are classified by the conditions of genesis.

Classification of Economic Minerals.— Classifications of economic minerals, and especially of ore deposits, have been much discussed, and are still debated. One which is adequate for all general purposes follows the classification of rocks already given, and comprises three classes of economic rocks and minerals: Those of igneous origin, those of sedimentary origin, and those of chemical origin by the agency of underground waters.

Igneous rocks have value as useful and ornamental stones, such as granite, serpentine or verde antique, trap rocks for road metal, etc., and occur in large masses, which as a rule are quarried by the simplest processes. Metal-

liferous ores, which are directly of igneous origin, though commonly supposed to be most abundant, are in fact of limited occurrence. Titaniferous iron ores such as are found in the Champlain district of New York, are igneous rocks peculiarly rich in iron. Ore bodies of other metallic compounds in some instances occur in such relations to igneous masses as apparently to have been formed from gases or waters accompanying the eruptions; but the chief part which igneous rocks play in relation to ores lies in the fact that they contain the metals in appreciable though minute quantities, and yield them to underground waters by which the metalliferous minerals are concentrated in ore bodies.

The class of sedimentary deposits of value includes many clays, sands, building stones, etc.; some iron ores; and coals. The class is characterized by the stratified structure of all materials contained in it. The strata are usually of great extent and moderate thickness, and their dimensions may be observed by tracing and measuring them throughout their appearance at the surface, or outcrop. From these observations the distribution of the strata where they extend beneath the surface, even to considerable depth, may be inferred. It may easily be understood how this method of looking underground is applied to any one tilted stratum, such as a coal bed; and though the operation becomes more complex, the principle remains the same when many beds of known succession are considered. The same method of observing the normal succession and thickness of strata and of drawing inferences as to the extent of formations underground is applied in districts where the layers have been bent into forms of troughs and arches, which are usually long, narrow, and parallel. Any stratum occurring at the surface bears known relations to all those below it, and thus the depth to any other stratum beneath any particular one seen may be estimated. Through many such estimates the form of the trough corresponding to any one stratum may be worked out and delineated by maps, drawings, or models. These principles, based on the regularity of stratification and of sequence of strata, are of most service in regard to coal beds and artesian waters, serving in the former case to afford a basis on which the amount of coal and the methods of mining may be determined in advance; and in the latter case to determine the depth at which an artesian flow of water may be reached. Good topographic and geologic maps are essential preliminaries to such economic investigations if the latter are to be reliable and of value.

Ore Deposits through Underground Waters. — Underground waters circulate deeply downward, laterally and upward in the earth's crust. They dissolve constituents of nearly all minerals, including gold, some of them readily, at surface pressures and temperatures, others in notable quantities only at pressures and temperatures of deeper zones. In circulating they bring together solutions which may differ in composition and may cause chemical reactions; or they may bring solutions into contact with wall rocks that exert similar chemical influences. The results are precipitation of metalliferous minerals in cavities, or the replacement of the wall rock itself by the ore. To these activities most ore deposits are due.

The metallic elements are contained in igneous rocks which are the original sources, but usually in minute quantities and disseminated through large masses and in compounds not available as ores. The universal combinations of iron and other bases with silica are obvious examples, as is also the frequent occurrence of pyrites or "fool's gold." Processes of chemical alteration, solution, and deposition are necessary steps toward concentration, and they may be more or less complex or often repeated. The reagent which accomplishes these chemical reactions is primarily that rain water which percolates beneath the surface and becomes ground water. Charged with oxygen and carbonic acid, it enters the superficial part of the zone of fracture, and is there active in producing oxides and carbonates and displacing silica, as already described. The important reaction upon metalliferous ores is the oxidization and carbonation of sulphides. Descending through the zone of cementation, where it may deposit much or all of the substances taken into solution, the water is warmed or heated, and is under constantly increasing pressure as it sinks deeper. It thus becomes a more active solvent for metalliferous minerals, and in the deep zone of recrystallization, where the movement is through capillary and subcapillary spaces, and is very slow, it may become even more potent. Its course in circulating, however deep and roundabout, is toward an outlet at the surface, and is ultimately upward. Among the ascending waters there may well be those which have escaped from the magmas of the interior and with substances in solution have joined the meteoric waters. The circulating underground solutions are directed in movement by the spaces in and between rock masses, spaces which are very minute in the deeper part of the zone of flow and fracture, and which are larger in the stronger rocks and nearer the surface. The larger ones, which are called trunk channels, are those in or near which ore bodies may form. The courses of descending and ascending waters are also controlled by relatively impervious beds, such as strata of clay, or shale, or schist, which may be too weak to maintain openings and too dense to absorb solutions. The spaces between rock masses are usually effects of deformation, fissures, faults, and folds, which are detected and traced through the fact that along them the rocks have departed from the relative positions or succession which they originally had, or have been brought into contact by intrusion, in the case of eruptive rocks. To understand the character of the structure, whatever it may be, involves primarily an understanding of the nature and original relations of the rock masses.

Large ore bodies if developed in open spaces can only occur in the zone of fracture and in the upper part of the zone of flow and fracture. If they are formed by replacement of the country rock by metalliferous minerals, their limits are determined by the mechanical, physical, and chemical conditions that in the individual case favored replacement. The relative parts played by descending, ascending, and laterally flowing solutions are unlike in the different cases, but are of practical significance in estimating the position and extent of ore bodies. The chemi-

cal reactions which may result in formation of ore minerals from gases, from solution, or by replacement, are controlled by pressure, temperature, and environment, in ways that are not fully understood and that are being actively investigated. It is, however, clear that the exceptional concentrates are to be sought in general in regions of disturbance, and, so far as the precious metals are concerned, especially in districts affected by intrusive igneous rocks; further that ore bodies are usually related to water channels which may best be followed through an understanding of the structure by which they were determined; and that within ore deposits processes of oxidation, carbonation, solution, and reprecipitation are in progress and produce the richest accumulations of ores.

Bibliography.— Text Books. In geology: Dana, 'Manual of Geology' (1895); Geikie, 'Text Book of Geology' (1893); Le Conte, 'Elements of Geology' (1896); Lyell, 'Principles of Geology' (1875); Scott, 'Introduction to Geology' (1897).

In physiography: Davis, 'Physical Geography' (1898); Gilbert and Brigham, 'Introduction to Physical Geography' (1902).

Special Topics. Bonney, 'Volcanoes, Their Structure and Significance' (1899); Dana, 'Corals and Coral Islands' (1890); Dutton, 'Tertiary History of the Grand Cañon District' (1882); A. Geikie, 'Ancient Volcanoes of Great Britain' (1897); J. Geikie, 'Earth Sculpture'; 'Great Ice Age' (1894); 'Genesis of Ore-Deposits' (American Institute Mining Engineers 1902); Kemp, 'Ore Deposits of the United States and Canada' (1900); Marr, 'Scientific Study of Scenery' (1900); Merrill, 'Treatise on Rocks, Rock Weathering, and Soils' (1897); Nicholson and Lydekker, 'Manual of Paleontology' (1889); 'Physiography of the United States' (Mon. Nat. Geog. Soc. 1896); Russell, 'Lakes of North America' (1895), 'Rivers of North America' (1898), and 'Glaciers of North America' (1897); Russell, 'Volcanoes of North America' (1897); Shaler, 'History of Our Continent' (1891), and 'Aspects of the Earth' (1889); 'Studies for Students' (Journal of Geology, University of Chicago); Van Hise, 'Principles of Pre-Cambrian Geology' (16th Ann. Rep. U. S. Geol. Survey, Pt. I., 1896); Williams, 'Geological Biology' (1895); Willis, 'Mechanics of Appalachian Structure' (13th Ann. Rep. U. S. Geol. Survey, Pt. II., 1892); Wright, 'Ice Age in North America' (1893); Zittel (Eastman's), 'Text-Book of Paleontology' (1896).

General Bibliographies.— The literature of the several branches of geological science is voluminous, but there are many articles published in serials which are of interest to the general reader. Reference to all the literature may be had through the following bibliographies: Darton, 'Catalogue and Index of Contributions to North American Geology 1732–1891' (Bull. U. S. Geol. Survey No. 127); Warman, 'Catalogue and Index of the Publications of the United States Geological Survey 1880–1901' (Bull. U. S. Geol. Survey No. 177); Weeks, 'Bibliography of North American Geology, Paleontology, Petrology, and Mineralogy for the years 1892–1900, Inclusive' (Bull. U. S. Geol. Survey No. 188).

The official bulletins, annual reports, and professional papers of the United States Geological Survey contain many special articles, and may be had on application to the director, Washington, D. C.

BAILEY WILLIS,
U. S. Geological Survey.

Geomancy, jē'ō-măn-sĭ (Greek, *gē,* the earth, and *manteia, divination*), a kind of divination formerly practised. Sparry, in his translation of Cattan's 'Geomancie' (written about the middle of the 16th century, and translated in 1591), says: "Geomancie is a science and art which consisteth of points, prickes, and lines made instead of the foure elements, and of the starres and planets of heaven. . . And this arte may be made on the earth or on white paper, or uppon any other thing whereon it may commodiously be done, so that the prickes and lines may be knowen." See DIVINATION; FUNG-SHUI.

Geomet'rical Mean of two numbers is that number the square of which is equal to the product of the two numbers; thus, the geometrical mean of 9 and 16 is 12, for $9 \times 16 = 144 = 12^2$. Hence the geometrical mean of two numbers is found by multiplying the two numbers together and extracting the square root of the product.

Geometrical Optics. See MIRROR; LENS; OPTICS.

Geometrical Progression. A series of quantities is said to be in geometrical progression when the ratio of each term to the preceding is the same for all the terms, that is when any term is equal to the product of the preceding term and a factor which is the same throughout the series. This constant ratio or factor is termed the *common ratio.* See PROGRESSION.

Geometridæ, jē-ō-mĕt'rĭ-dē, a family of moths whose larvæ walk by arching the body and so bringing the hinder feet (prolegs) close up to the forward (thoracic) feet, and again reaching forward. Hence they are called "loopers," "inch-worms," etc. See MEASURING-WORMS.

Geometry. The characteristic aspiration of scientific man is to conceive the universe as a genuine cosmos. Of scientific generalizations, one of the most obvious and important, and one which is at the same time historically among the first, has reference to *order,* namely, that the universe presents or at least suggests two grand order-types: order of coexistence or of side-by-side, that is, order-in-Space; and order of succession or of before-and-after, that is, order-in-Time. These seem to be logically independent. Which one, if either, is the more fundamental remains undetermined. The two combine to give the category of motion, and accordingly the world presents alike to the sense and to thought two complemental aspects, the static and the dynamic. To these and their combination correspond the fundamental sciences. The mentioned order-types taken in the abstract are the subject-matter of mathematics; the former yielding pure geometry, the latter pure analysis; the two together, analytico-geometry and geometrico-analysis.

By perusal of the articles that immediately follow, the reader may gain some notion of the wondrously diverse and manifold significance

assumed by the term geometry in modern times. The view thus gained may be further matured and enriched by reference to such other articles of this work as: CURVES, HIGHER PLANE; CURVES OF DOUBLE CURVATURE, THEORY OF; SURFACES, THEORY OF; MENSURATION; HYPERSPACES; ANALYSIS SITUS; QUATERNIONS; CALCULUS OF VARIATIONS, THE; CALCULUS, THE INFINITESIMAL; HARMONIC ANALYSIS; EQUATIONS, DIFFERENTIAL; INVARIANTS AND COVARIANTS. Some of these latter are indeed primarily analytic. They nevertheless serve to illustrate, not only the unity of mathematics in general, not merely the complemental relationship in which the two grand divisions, geometry and analysis, stand to each other, but in particular the universal pervasiveness of geometric concepts and methods.

CASSIUS J. KEYSER,
Adrian Professor of Mathematics, Columbia University.

Geometry, History of the Elements of. The history of the science of geometry begins in Greece. It is true that mensuration was developed to a considerable extent at an early period in Egypt, Babylonia, and India, and that this work involved the measurement of angles in the astronomical observations of the people of these countries, but the abstract science of form never attained any prominence before the Greek period. In Egypt, for example, the harpedonaptæ (rope stretchers) knew the right-angled triangle whose sides are 3, 4, 5, and stretched their ropes to lay out a right angle in much the same way that a modern surveyor erects a perpendicular by the help of his chain; but there is no evidence that the Egyptians thought of proving the Pythagorean theorem. Herodotus testifies to the fact that the Egyptians divided the land that was subject to the overflow of the Nile, into quadrilaterals, and therefore they must have had some knowledge of elementary surveying. Indeed, long before this time Ahmes (see ALGEBRA, HISTORY OF THE ELEMENTS OF) gave certain rules, partly incorrect, for measuring areas and volumes, in particular an interesting one for the area of the circle, $a=(d-\frac{d}{9})^2$. All of this work was, however, very elementary, and the rules were merely the result of unscientific observation.

In Greece the science of geometry may be said to have begun with Thales (q.v.), who was born at Miletus, c. 640 B.C., and who died at Athens in 548. Brought up in contact with the learning that drifted from the East to the shores of the Mediterranean, in his younger days devoted to those commercial pursuits that made Miletus a centre of wealth, he traveled extensively, and devoted his later years to philosophy. From Egypt he seems to have taken back to Ionia whatever of primitive geometry was known, and his school at Miletus was devoted to the study of philosophy, astronomy, and the science of form. Thales is supposed to have proved the propositions concerning the equality of vertical angles, the sides opposite the equal angles of a triangle, the determination of a triangle by one side and two angles, the bisection of a circle by a diameter, and the nature of an angle inscribed in a semicircle. His most famous pupil was Pythagoras (q.v.), who was born at Samos in 580 and died in southern Italy in 501. A man of great personal magnetism, a mystic, and versed in the lore of the Orient, Pythagoras made his school at Crotona, the mathematical centre of his time. Although none of his works are extant, if, indeed, he wrote any, it is known that he proved the famous theorem which bears his name (Euclid I., 47), a proposition known empirically to the Egyptians, at least for special cases. Pythagoras also gave much attention to the study of proportions and irrational quantities, always from the standpoint of geometry. He also knew the size of the angle of a regular n-gon, and the stellar pentagon was made the badge of his order.

The century following Pythagoras was one of discovery. Among the most noted geometers was Hippocrates of Chios, c. 440 B.C., who must not be confounded with the great physician who wrote on the mystic number 7. Hippocrates, who had come in contact with the Pythagoreans, wrote the first Greek text-book on mathematics, and designated the geometric figures by letters placed at the angles. To him is due the first example of the quadrature of a curvilinear figure, a proposition known as the lunes of Hippocrates. The theorem asserts that if semicircles be described on the three sides of a right-angled triangle in such way as to form lunes on the two shorter sides, the area of the lunes equals that of the triangle. In his attempt to duplicate the cube he showed that the problem can be solved if two mean proportionals can be found between e and $2e$, where e is the edge. This problem was one of the three famous ones of antiquity, the others being to square the circle and to trisect any given angle. It is now known that these problems, easily solved if the necessary instruments are allowed, cannot be solved merely by the use of an unmarked ruler and a pair of compasses. Contemporary with Hippocrates lived Hippias of Elis, to whom is probably due the quadratrix which Dinostratus afterward studied and named. About the same time Antiphon and Bryson sought the quadrature of the circle by means of inscribed and circumscribed polygons, the number of sides being successively doubled, and with them begins the theories of limits and of exhaustions.

The influence of Plato (429–348 B.C.) on elementary geometry was greater than is usually supposed. He found the science in a disordered state, a mass of unrelated propositions, very likely covering much of plane geometry as found in Euclid. His philosophic mind led him to the attempt to put the science on a more satisfactory foundation by insisting upon accuracy of definition, upon a limited number of postulates (including axioms), and upon definite bounds to plane geometry. As a result, only those figures capable of construction by the help of an unmarked ruler and the compasses are recognized as belonging to the field of elementary geometry. To the school of Plato is also due the analytic method of attack in geometry, including the *reductio ad absurdum.* Although not himself a great discoverer in mathematics, two of Plato's pupils reached high eminence in geometry. Of these the first was Eudoxus, who extended the theory of proportion, founded the doctrine of similar figures, gave much attention to the problem of the golden section, applied the method of exhaus-

tions to the mensuration of solids, and wrote the first text-book upon stereometry. The second was Menæchmus, who, in his attempts to solve the duplication (or Delian) problem, discovered the conic sections. The study of the five regular polyhedra also occupied the attention of Plato's pupils, so much so that they received the name of Platonic bodies.

The influence of Aristotle was directed to the encouragement of the study of the history of geometry and the applications of mathematics. As a result, his followers began to collate the work of the earlier Greeks and to consider its relation to physical problems. Elementary geometry now enters the text-book period, and several attempts at works of this character appear in the fourth century, B.C. This movement culminated in the works of Euclid (q.v.), a man of whose personal life we know practically nothing save that he taught and wrote in Alexandria c. 300 B.C. Probably of little originality in the way of mathematical discovery, Euclid had a genius for compilation, and this showed itself in the Στοιχεῖα (connected series), or *Elements*, as it was called in later times. This famous work is devoted principally to plane geometry, and it has formed the basis of practically all elementary treatises up to the present time. The natural effect of Euclid's work was to give the impression that the field of elementary plane geometry was exhausted. Mathematicians therefore directed their energies to the applications of geometry, to stereometry, and to conics. Archimedes (q.v.), writing at Syracuse c. 240 B.C., opened the great field of mathematical physics and carried the study of elementary geometric solids to its greatest height among the Greeks. To him is also due the limits $3\frac{1}{7}$ and $3\frac{10}{71}$ for π, the study of the spiral that bears his name, and the quadrature of the parabola. Apollonius of Perga (q.v.), "the great geometer," wrote eight books on conics c. 225 B.C., and set a standard which still influences the text-books in analytic geometry. Of the minor geometers who followed Apollonius, two may be mentioned. Nicomedes (c. 180 B.C.), who invented the conchoid, a curve which easily solves the trisection problem, and his contemporary, Diocles, whose cissoid furnishes an easy means for duplicating the cube. Of the later Greek geometers the most noteworthy is Hero of Alexandria (see HERO OF ALEXANDRIA), whose personal history, like that of Euclid, is practically unknown, and to whom it is difficult to assign a date even within a century. His most interesting contribution to elementary geometry is the formula for the area of a triangle in terms of the sides,

$$\Delta = \sqrt{s(s-a)(s-b)(s-c)}.$$

Possibly contemporary with Hero lived Menelaus, whose theorem, known in the Middle Ages as the *Regula sex quantitatum*, has made his name well known. His most important discovery, however, was the projective property of the anharmonic ratio. By this time the age of discovery in geometry had passed in Greece, and the efforts of the Neopythagoreans at Alexandria were productive of little that is remembered. Pappus (c. 300 A.D.), an Alexandrian mathematician and geographer, may be called the last of the Greek geometricians who showed any originality. He suggested the theory of involution of points, restated the projective property discovered by Menelaus, and discovered the theorem (which also bears the name of Guldin) concerning the volume generated by a plane figure revolving about an axis.

The Orientals contributed but little to elementary geometry, their interests being rather directed to algebra (q.v.) and trigonometry (q.v.), with astronomy as the leading application for their advanced mathematics. Brahmagupta, a Hindu, born in 598, generalized the Hero formula, showing that the area of an inscribed quadrilateral is expressed by

$$A = \sqrt{(s-a)(s-b)(s-c)(s-d)},$$

but aside from problems in mensuration, geometry played but little part in India. The Bagdad school of c. 800 was chiefly interested in geometry only as it concerned trigonometry, and its greatest contribution to the science consisted in the preservation of the works of the Greeks. Euclid, for example, was first made known to Christian Europe in the Middle Ages through a translation from the Arabic by Adelhard of Bath, c. 1120.

Among the first books on mathematics to be printed was Euclid's 'Elements' (1482), a fact which made this famous work again a standard. The appearance of this classic had the same effect as in the later centuries of Greek culture, to encourage commentators rather than investigators. In the way of original work, only such minor efforts as the study of stellar polygons and the geometry of a single opening of the compasses characterized the closing decades of the Middle Ages and the opening years of the Renaissance. Not until Kepler (q.v.) suggested the principle of continuity (1604), and Cavalieri set forth the method of indivisibles (1629; published in 1635), and Desargues began the theory of modern geometry (1639), was there any material advance in the subject. When, however, this advance was undertaken it was so vigorous as to lead from elementary geometry to higher fields. In the latter part of the 19th century there was a renaissance of investigation in the elementary domain, leading to an interesting but not very productive study of the geometry of the circle and the triangle, notably in the work of Lemoine and Brocard. The 19th century also saw an exhaustive study of non-Euclidean geometries (q.v.), those based on other postulates than those of Euclid. This study began with the works of Lobachevsky and Bolyai (qq.v.), and has led to very interesting results, hardly to be ranked, however, in the domain of elementary geometry.

Bibliography.—Chasles, 'Aperçu historique sur l' origine et le developpement des méthodes en géométrie' (Paris 1875); Klein, 'Famous Problems of Elementary Geometry' (transl. by Beman and Smith, Boston 1895); Loria, 'Die hauptsächlichsten Theorien der Geometrie in ihrer früheren und jetzigen Entwickelung' (transl. by Schütte, Leipsic 1888); Allman, 'Greek Geometry from Thales to Euclid' (Dublin 1889); Gow, 'History of Greek Mathematics' (Cambridge 1884); Bretschneider, 'Die Geometrie und die Geometer vor Eukleides' (Leipsic 1870); Cantor, 'Geschichte der Mathematik' (Leipsic 1880–98, various editions); Tannery, 'La géométrie grecque' (Paris 1887).

DAVID EUGENE SMITH.
Professor of Mathematics, Teachers College, Columbia University, New York.

Geometry, Cartesian.—Between number and the properties of number, on the one hand, and space and the properties of space, on the other, there is, strictly speaking, no *resemblance*; and the science of number, *i.e.*, algebra or analysis, and the science of space, *i.e.*, geometry, are essentially, psychologically, and logically independent doctrines. But despite their fundamental unlikeness and independence, there is between the two, broadly speaking, a fact-to-fact *correspondence*. For example, there subsists, or may be established, a unique and reciprocal, or one-to-one, correspondence between the real numbers and the points of a straight line or other curve; between the real numbers and the lines of a flat pencil (see PROJECTIVE GEOMETRY) or the tangents to a curve; between the pairs of real numbers and the points or the lines of a plane; between the triplets of real numbers and the circles of a plane or the points or planes of space; between the quartets (permutations four at a time) of the real numbers and the lines or the spheres of space (see LINE GEOMETRY AND ALLIED THEORIES). The theory of the correspondence thus simply exemplified, the logically organic body of propositions setting it forth, is the *science* called analytic or algebraic geometry. It is often called coördinate geometry from the fact that the set of numbers determining or corresponding to a geometric element are called the coördinates of the element. By virtue of the correlation between analytic facts and geometric facts, it is frequently possible, when facts of the one type are known, to infer the corresponding facts of the other, and so to investigate space analytically (algebraically, arithmetically) and to investigate number geometrically. Under either of these aspects, analytical geometry appears as a *method*: analytic investigation of geometry, geometric investigation of analysis. Usually it is the former aspect under which the doctrine is regarded, geometry being the subject-matter, and analysis the means or instrument of research.

The science presents numerous branches or varieties. These differ among themselves in various ways. Two varieties may differ in respect to what is often called their 'spaces,' *i.e.*, in respect to the domains, fields, regions, or extents (as curve, surface, space) containing the configurations with which they deal. Thus arise such distinctive designations as geometry of (on, in) a plane, or plane geometry, geometry on a surface or a curve, geometry of space. Again, a given 'space' or domain may be conceived in countless ways. It may be conceived as the assemblage of its points or of its lines or of its circles, and so on. Accordingly two geometries relating to a same 'space' or domain may yet differ in respect to their *primary* elements, in respect, *i.e.*, to the elements of which the configurations investigated are regarded as composed. So arise, for example, such distinct theories as the point, line, circle, . . . , geometries of the plane, and the point, line, plane, circle, sphere, . . . , geometries of space. Once more, as will appear in this and related articles herein cited, a chosen element in any given domain may be referred to different kinds of configurations of reference; it may, in other words, be determined by, made to correspond to, or be associated with, different kinds of *coordinate systems*. Upon the choice of coordinate system depends, *ceteris paribus*, the analytic form of a given geometric theory. Accordingly, two geometries that are identical in content may differ in form, in algebraic guise or garb.

The primitive, by far the oldest, variety of analytic geometry, the parent of all other varieties, is the Cartesian, so called from its founder, René Descartes (1596–1650). Though originally a plane geometry, its procedure is equally adapted, and has been extended, to spaces of every dimensionality in points (see HYPERSPACES). It is characterized partly by its primary element, the point, and partly by its coordinate system, which will be explained below. Descartes' geometry, contained in his *Discours de la méthode pour bien conduire sa raison et chercher la vérité, dans les sciences*, published in 1637, is to be regarded, on account of its influence on mathematics and upon knowledge in general, as one of the very greatest contributions ever made to science. Descartes was not indeed the first to apply algebra to geometry. That had been done by «the great geometer,» Apollonius of Perga (about 260–200 B. C.), who had referred the conic sections to their tangents and diameters, expressing the relations by linear equations between areas. In the 14th century Oresme and others had applied numbers («latitudo» and «longitudo,» precursors of the modern ordinate and abscissa) to refer a point to two chosen rectangular lines or axes. The point was confined, however, to the first quadrant. In this way the straight line, the circle and the parabola were studied. Other predecessors of Descartes were Vieta (1540–1603), Cavalieri (1598–1647), Roberval (1602–1675), and the brilliant Fermat (1601–1665), who more nearly than any other approaches Descartes in his understanding of the analytic method. Even Fermat, however, had apparently not seen, what Descartes saw, the possibility of referring at once to a single coördinate configuration different curves of different orders.

The following paragraphs give a very brief account of the elements of Cartesian, or ordinary analytical, geometry with special reference to the straight line and the conic section and the simplest configurations of space.

THE PLANE.

Cartesian Coordinates.—Any two straight lines, as XX' and YY', are assumed as lines of reference, or *coordinate axes*. The former is X-axis or axis of *abscissæ*, the latter is Y-axis or axis of *ordinates*. The point O is the *origin* of *distances;* the (half) line OX, the *origin* of *angles*. Distances on or parallel to the X-axis are regarded *positive* (+) if measured *rightward*, *negative* (−) if *leftward*. Distances on or parallel to the Y-axis are regarded *positive* if measured *upward*, *negative* if *downward*. Angles are regarded *positive* or *negative* according as they are conceived to be generated by *counter-clockwise* or by *clockwise* rotation. (See TRIGONOMETRY.) Conceive drawn all lines parallel to the X-axis and all parallel to the Y-axis. Any pair of these lines, one of the former set and one of the latter, determine (intersect in) a point, and all points of the plane are thus determined. Conversely, any point

determines (is the common point of) a pair of the lines, and all the pairs of the parallels are

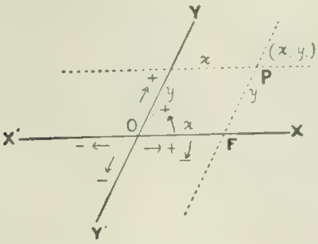


FIG. 1.

thus determined. Obviously any line-pair or its *point* determines two real numbers: the distances OF and FP in terms of any convenient unit. These, denoted respectively by x and y, are named respectively the *abscissa* and the *ordinate*, together the *coordinates*, of the point. Conversely, any *pair* of real numbers determine a point. It is thus seen that, by means of a pair (system) of axes, a one-to-one correspondence is established between the *points* of the plane and the assemblage of real number *pairs*. Any such point and its pair of coordinates are said to *correspond*; the point is said to depict or represent its pair of numbers geometrically, and the number pair is said to represent the point arithmetically or algebraically or analytically.

Transformation of Cartesian Coordinates.—It is plain that (the unit being the same) the coordinates of a point referred to one pair of axes will not coincide with its coordinates referred to a different pair. Formulæ for expressing the old in terms of the new coordinates are exceedingly useful. To find such formulæ, consider first the case where the old and new origins coincide. Denote by α and β the angles made with OX by OX' and OY' respectively. Let x and y be the old, and x' and y' the new, coordinates of any point P, and denote the

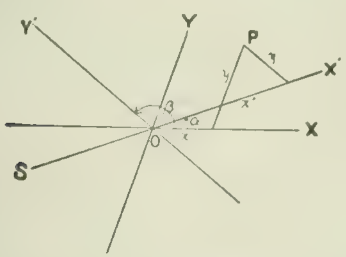


FIG. 2.

angle XOY by ω. The formulæ in question are readily seen to be: $x \sin \omega = x' \sin (\omega - \alpha) + y' \sin (\omega - \beta)$, $y \sin \omega = x' \sin \alpha + y' \sin \beta$. If the origins do not coincide and if h and k be the coordinates of the new origin O' with reference to the old axes, the formulæ of transformation are found by adding $h \sin \omega$ and $k \sin \omega$ respectively to the right-hand members of the foregoing equations. Most commonly the axes are assumed to be *rectangular*. In that case, $\omega = 90°$, $\sin \omega = 1$, $\beta = (90° + \alpha)$, and the equations of transformation become: $x = x' \cos \alpha - y' \sin \alpha + h$, $y = x' \sin \alpha + \cos \alpha + k$. The equations for effecting the *inverse* transformation are found by solving for x' and y' the equations of the *direct* transformation.

Polar Coordinates.—Though it is never necessary, it is often convenient, to employ other than Cartesian coordinates to determine the position of a point. Of such other coordinate systems, the most familiar is the *polar*. About any point O (as center), called the *pole*, suppose drawn all possible concentric circles; also suppose drawn out from the pole all possible *rays* (half-lines). Any circle and any ray determine (intersect in) a point, and all points of the plane are thus determined; conversely, any point determines (is common to) a circle

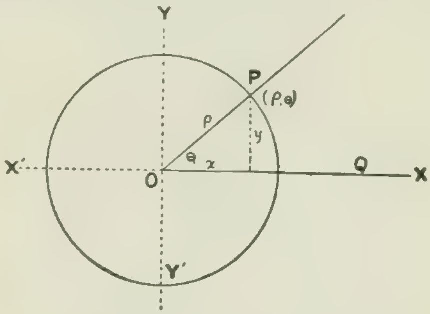


FIG. 3.

and a ray, and all pairs of such lines (circle and ray) are thus determined. A circle is given by its radius ρ, and a ray by its angle θ made with a fixed ray, as OQ, called the *initial line* or *polar axis*. All the circles are obtained by letting ρ vary from 0 to ∞, and all rays by allowing θ to vary from 0 to 2π or 360°. Obviously, to any pair of values (within the ranges of variation mentioned) of ρ and θ there corresponds one point, and conversely. The pair of numbers (ρ, θ) determining or determined by a point P are called the *polar coordinates* of P. In particular, ρ is called the *radius vector*, and θ the *vectorial angle*, of P.

Transformations from Cartesian to Polar Coordinates.—We present here only the simplest and most important case, *viz.*, that wherein the Cartesian axes are rectangular, the origin coinciding with the pole, and the positive half of the X-axis with the polar axis. Let P be any point. It is clear, Fig. 3, that the equations of direct transformation are: $x = \rho \cos \theta$; $y = \rho \sin \theta$. Solving these for ρ and θ, the equa-

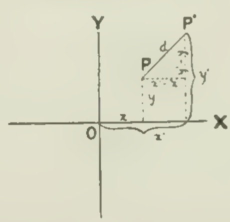


FIG. 4.

tions of the inverse transformation are found to be: $\rho = \sqrt{x^2 + y^2}$; $\theta = \tan^{-1}\frac{y}{x}$.

Distance between Points.—Henceforth the axes will be assumed to be rectangular. Let P and P' be any two points, of coordinates

(x, y) and (x', y') respectively. From Fig. 4, by the Pythagorean theorem, $d^2=(x-x')^2+(y-y')^2$, whence the distance between any two points (x, y) and (x', y') is found to be $d=\sqrt{(x-x')^2+(y-y')^2}$. Transforming to polar coordinates (ρ, θ) and (ρ', θ'), and reducing, there results $d=\sqrt{\rho^2+\rho'^2-2\rho\rho' \cos(\theta-\theta')}$, in agreement with the Law of Cosines. (See TRIGONOMETRY.)

Division of Line-segment in Given Ratio.— Suppose P divides the segment P_1P_2 in the

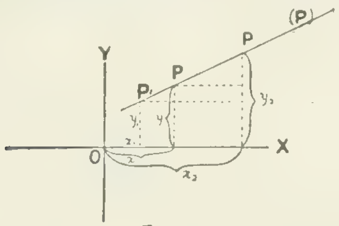


FIG. 5.

ratio, $m_1:m_2$. By hypothesis, $P_1P:PP_2=m_1:m_2$; hence, from similar triangles,

$$m_1:m_2=(x-x_1):(x_2-x)=(y-y_1):(y_2-y);$$

these equations, solved for x and y, yield

$$x=(m_1x_2+m_2x_1):(m_1+m_2)$$

and $$y=(m_1y_2+m_2y_1):(m_1+m_2).$$

If the division be *exterior*, *i.e.*, if P be *outside* the segment, as at (P), one term of the ratio is negative, and the formulæ are

$$x=(m_1x_2-m_2x_1):(m_1-m_2),$$

$$y=(m_1y_2-m_2y_1):(m_1-m_2).$$

If P be the interior mid-point, $m_1=m_2$, and $x=(x_1+x_2):2$, $y=(y_1+y_2):2$. If $m_1=-m_2$, P is the exterior mid-point and its coordinates are both infinite unless the segment is parallel to an axis, in which case but one of the coordinates is infinite.

Locus of Equation.—An equation, $f(x, y)=0$, between the variables x and y, *defines* a system or aggregate or assemblage of *pairs* of numbers, *viz.*, the assemblage of pairs of values of x and y that satisfy the equation. To each of such pairs of (real) values, a system of axes and a unit of distance being chosen, there corresponds a point. The assemblage of all the points so determined constitute the (real) *locus* of the equation. In general, as x or y varies continuously, y or x will vary continuously, and accordingly the corresponding point will trace a continuous path, some *curve*, the locus in question. Conversely, if a point move subject to some geometric condition, its path will be a curve such that the coordinates of its points and of no other satisfy some equation. An equation and its locus or curve are each said to represent the other, and, from the properties of either, corresponding properties of the other can be inferred. An equation defines its locus, a locus defines its equation. Any equation, $f(x, y)=0$, is, of course, satisfied by countless pairs of values of which either (or both) is imaginary or complex. To such a pair no real or «visible» point of the plane corresponds. Nevertheless, in order that the geometric and analytic languages shall be coextensive, it is customary to say that any pair of numbers of which at least one is complex represents an «imaginary point» of the plane. Accordingly the locus (in generalized sense) of an equation is composed of a real part and an imaginary part, the latter consisting of all imaginary points whose coordinates satisfy the equation. The intersection of two loci or curves consists of the points (real and imaginary) whose coordinates satisfy the equations of both curves. The foregoing remarks respecting equations in Cartesian coordinates apply equally to equations in polar coordinates.

The Straight Line and the Linear Equation.— Let (1) be any line through the origin, and denote by θ its angle with OX, and let $m=\tan\theta$. Obviously the x and y of any (every) point of (1) and of no other point are connected by the equation $y=mx$, which therefore defines, and is called the equation of, line (1). To each line through O there corresponds one value of the *slope* m, and conversely. Any line not through O is parallel to a line through O. Hence (2), parallel to (1), represents any line not through O. Clearly by adding b to any y of (1) the corresponding y of (2) is found, while corresponding x's are the same. Hence the equation of (2) is $y=mx+b$. The quantity b is called the *Y-intercept* of the line; if b is zero, (2) goes through O, and conversely. The equation represents a line for every pair of real values of m and b; conversely,

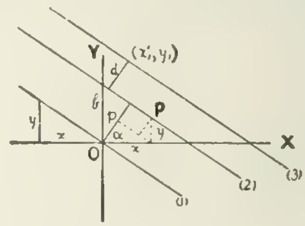


FIG. 6.

every line has a slope and a Y-intercept (positive or negative). Hence every equation of 1st degree in x and y represents a straight line, and conversely. Solving the equation $y=0$ of the X-axis and the equation of (2) as simultaneous, the intersection is found to be $\left(-\frac{b}{m}, 0\right)$, or $(a, 0)$, whence the equation of (2) may be written $\frac{x}{a}+\frac{y}{b}=1$, called the *intercept* or *symmetric form*, a being the X-intercept. The equation $y=mx+b$ is called the *slope form*. Other forms are readily obtainable, of which one of the most important is the so-called *standard* or *normal* form, $x\cos\alpha+y\sin\alpha-p=0$, readily deducible from the figure, where p is the length of the perpendicular (normal) from O to (2), α is the angle indicated, and P is any point of (2). The *general* equation

$$Ax+By+C=0$$

can be reduced to any of the foregoing forms. To reduce it to the normal form, it suffices to multiply by the *normalizing factor*, $1:\sqrt{A^2+B^2}$, yielding

$$\frac{Ax}{\sqrt{A^2+B^2}}+\frac{By}{\sqrt{}}+\frac{C}{\sqrt{}}=0,$$

where $\cos\alpha = A:\sqrt{\quad}$, $\sin\alpha = B:\sqrt{\quad}$, $p = -C:\sqrt{\quad}$, that sign before the radical being chosen which renders the constant (or absolute) term negative. A line is determined by yet other pairs of data, as by its slope m and a given point (x_1, y_1) or by two points (x_1, y_1), (x_2, y_2), and its equation assumes corresponding forms, which may be called respectively the *point-slope* form and the *two-point* form. The former plainly is $y - y_1 = m(x - x_1)$. The necessary and sufficient *condition* that this line shall pass through (x_2, y_2) is $y_2 - y_1 = m(x_2 - x_1)$. Combining the two equations by division, there results the two-point form, $(y - y_1):(y_2 - y_1) = (x - x_1):(x_2 - x_1)$, equation of the line fixed by the points (x_1, y_1), (x_2, y_2).

Distance from Point to Line.—The equation of any line (3), parallel to (2), Fig. 6, is $x\cos\alpha + y\sin\alpha - p' = 0$, where $p' = p + d$. The condition that (x', y') be on (3) is $x'\cos\alpha + y'\sin\alpha = p'$. Subtracting p from both members, we find $d = x'\cos\alpha + y'\sin\alpha - p$, distance from (x', y') to $x\cos\alpha + y\sin\alpha - p = 0$.

Angle between Lines.—Let ϕ be the angle between two lines whose slopes are m_1 and m_2. Then $\tan\phi = \pm(m_1 - m_2):(1 + m_1 m_2)$. If $\phi = 0$, then $\tan\phi = 0$, and $m_1 = m_2$, condition of parallelism. If $\phi = 90°$, then $\tan\phi = \infty$, and $1 + m_1 m_2 = 0$, whence $m_1 m_2 = -1$, condition of perpendicularity.

The Circle and Its Equation.—About any point (a, b) as center describe a circle of any radius r. Let $P(x, y)$ be any point of the circle. A glance at the figure shows that x and y are connected by the relation

$$(x-a)^2 + (y-b)^2 - r^2 = 0,$$

equation of the circle. By comparison with the equation $x^2 + y^2 + 2Ax + 2By + C = 0$, the

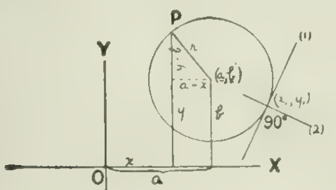


FIG. 7.

latter is found to represent a circle of center $(-A, -B)$, and radius $\sqrt{A^2 + B^2 - C}$. If the radicand be negative, the radius and hence the circle is imaginary. The tangent (1) to the circle at the point (x_1, y_1) is

$$(x_1 - a)(x - a) + (y_1 - b)(y - b) - r^2 = 0;$$

the normal (2) is

$$(y_1 - b)(x - x_1) - (x_1 - a)(y - y_1) = 0.$$

If the center be at the origin, the circle is $x^2 + y^2 = r^2$, the tangent at (x_1, y_1) is $x_1 x + y_1 y - r^2 = 0$, and the normal is $y_1 x - x_1 y = 0$. The line $y = mx + c$ is tangent to $x^2 + y^2 - r^2 = 0$ when and only when the distance from O to the line is r, *i.e.*, when $c = \pm r\sqrt{1 + m^2}$; hence $y = mx \pm r\sqrt{1 + m^2}$ is tangent to the circle and as m varies completely envelops the circle. Similarly it may be found that for every value of m the line $y - b = m(x - a) \pm r\sqrt{1 + m^2}$ is tangent to the circle of center (a, b) and radius r. This equation (in slope form) of the tangent is sometimes called the *magic* equation of the tangent. By transformation of coordinates or otherwise the polar equation of the circle of center (ρ', θ') and radius r may be found to be $\rho^2 - 2\rho'\rho\cos(\theta - \theta') + \rho'^2 - r^2 = 0$.

The Conic Sections: Ellipse, Parabola, Hyperbola.—The equation of the path, locus, or curve generated by a point (x, y) which so moves that the ratio of its distance from a fixed point (called the *focus*) to its distance from a fixed straight line (called the *directrix*) is a constant e (called the *eccentricity*) is of the form $Ax^2 + By^2 + Cxy + Dx + Ey + F = 0$; conversely, the locus of every equation of second degree is a curve of the kind in question. All such curves are called *conics* or *conic sections*, because any one of them is the intersection of a plane and a cone, where by cone is meant the surface that may be generated by a straight line revolving about a fixed point (vertex) and making a constant angle with a fixed line (axis) through the point; conversely, every such intersection is a conic, curve of second degree. The conics, of the very greatest importance alike in pure and in applied mathematics (cf. ASTRONOMY), were studied by the ancients (cf. APOLLONIUS), who conceived them as intersections of plane and cone. There are three species of conics, a conic being named *ellipse* (E), *parabola* (P), or *hyperbola* (H), according as the eccentricity $e <$, $=$, or > 1. The foregoing equation represents an E, a P, or an H, according as $4AB - C^2$ is *positive*, *zero*, or *negative*. Among the conics of any species are *degenerate* or *degraded* or so-called *improper* conics of that species. The degraded form of E is any pair of imaginary straight lines intersecting in a real point (center of the conic, vertex of the cone); any pair of parallel real straight lines is a degraded P; and any pair of non-parallel real lines is a degenerate H. By suitable transformations of coordinates the equation of any conic may be made to assume a simplest, named *standard*, form. The standard forms of the species are presented below.

Ellipse.—The standard form of the E is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, in which a is the half *major*, and b the half *minor*, *axis* of the E. The focus

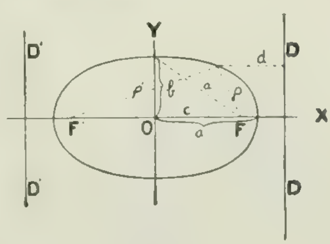


FIG. 8.

and directrix are respectively F and DD or F' and $D'D'$. The equations of the directrices are $x = \pm a:e$; $e = c:a$. The sum of the focal radii of any point of E is $\rho + \rho' = 2a$, a property often taken as definition of the E, instead of the relation $\rho = ed$. If $b = a$, the E is a circle;

hence the circle is an E of coincident foci and eccentricity zero. The area of E is πab.

Hyperbola. — The standard equation is $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$, where a is half of the *transverse*, and b is half of the *conjugate, axis*. The equation represents the curve composed of the two branches (1) and (2). For any point,

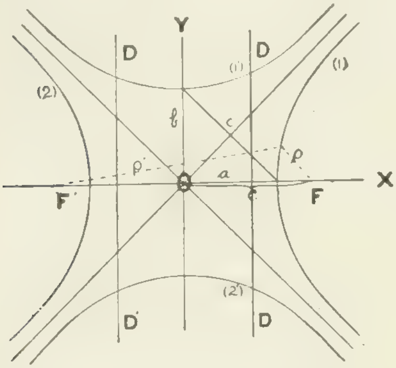


Fig. 9.

$\rho'-\rho=2a$, a defining property of the H. The H composed of (1′) and (2′) is called *conjugate* to the other one and has $\frac{x^2}{a^2}-\frac{y^2}{b^2}=-1$ for its equation. The two oblique lines through O *tangent* to both H's at ∞ are named *asymptotes* of the curves. The equations of the asymptotes are $y=\pm\frac{b}{a}x$. The corresponding lines of the E are imaginary, $y=\pm i\frac{b}{a}x$. If $a=b$, the H, $x^2-y^2=a^2$, is called equiaxial or equilateral or *rectangular*, its asymptotes being at right angles. It is related to the general H as the circle to the general E.

Parabola.—The standard equation is $y^2=4px$. The equation of the directrix is $x=-p$; the coordinates of the focus are $(p, 0)$; for any

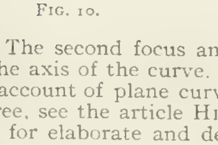


Fig. 10.

point $\rho=d$. The second focus and the center lie at ∞ on the axis of the curve.

For some account of plane curves of higher order or degree, see the article Higher Plane Curves, and for elaborate and detailed treatment of the analytical geometry of the plane, including exhaustive discussion of the conics, see works cited in bibliography below. We add here a note introducing the Cartesian geometry of

Space.

Coordinate Configurations. — Space is tri-dimensional in points, three independent data being necessary and sufficient to determine the position of a point. Of such data the simplest are the distances, Cartesian rectangular *coordinates*, x, y, z, of a point P from three fixed planes XOY, YOZ, ZOX, each perpendicular to the other two. These *coordinate planes* determine three lines, called *coordinate*

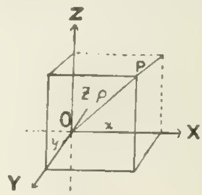


Fig. 11.

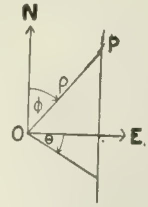


Fig. 12.

axes, having a common point O, the *origin*. Positive directions are indicated by the arrowheads. The polar coordinates of a point P, Fig. 12, are the radius vector ρ, and the vectorial angles θ and ϕ, reckoned respectively from the pole O and the *polar axes* OE and ON. If the pole coincide with the origin, and the polar axes with OX and OZ, then $x=\rho\cos\theta\sin\phi$, $y=\rho\sin\theta\sin\phi$, $z=\rho\cos\theta$, $\rho=\sqrt{x^2+y^2+z^2}$, $\tan\theta=y:x$, $\cos\phi=z:\rho$, formulæ of transformation from either system to the other. If α, β, γ are the direction angles (made respectively with OX, OY, OZ) of the radius vector ρ of any point P, Fig. 11, then $x=\rho\cos\alpha$, $y=\rho\cos\beta$, $z=\rho\cos\gamma$, and $1=\cos^2\alpha+\cos^2\beta+\cos^2\gamma$, sum of squares of *direction-cosines* of ρ. Any linear equation $Ax+By+Cz+D=0$ represents a plane. The symmetric equation of a plane is $\frac{x}{a}+\frac{y}{b}+\frac{c}{z}=1$, a, b, c being the axial intercepts extending from O to the plane. In normal form the equation of the plane is $x\cos\alpha+y\cos\beta+z\cos\gamma=p$, where p is the length, and $\cos\alpha$, $\cos\beta$, $\cos\gamma$ are the direction-cosines, of the perpendicular from O to the plane. To convert $Ax+By+Cz+D=0$ to the normal form it suffices to multiply it by the normalizing factor, $1:\sqrt{A^2+B^2+C^2}$, the new coefficients $A:\sqrt{}$, $B:\sqrt{}$, $C:\sqrt{}$, being $\cos\alpha$, $\cos\beta$, $\cos\gamma$, and $D:\sqrt{}$ being $-p$. The angle θ between two planes $Ax+By+Cz+D=0$ and $A'x+B'y+C'z+D'=0$ is determined by the relation

$$\cos\theta=(AA'+BB'+CC'):\sqrt{(A^2+B^2+C^2)(A'^2+B'^2+C'^2)},$$

whence the planes are parallel when and only when $A:A'=B:B'=C:C'$, and are perpendicular when and only when $AA'+BB'+CC'=0$. The equations of any two of the planes containing a line, *together* represent the line. Accordingly in space the line has *two* equations. Its simplest equations are those of any two of the three planes containing the line and being perpendicular respectively to the coordinate planes, as $x=mz+p$, $y=nz+q$. Such a pair are unsymmetric. Symmetric equations of the line directed by α, β, γ, and going through the point (x_1, y_1, z_1) are

$$(x-x_1):\cos\alpha=(y-y_1):\cos\beta=(z-z_1):\cos\gamma,$$

in number three of which but (any) two are independent. The angle θ between two lines whose direction-cosines are proportional to

L, M, N and L', M', N', respectively, is determined by the relation

$$\cos\theta = (LL' + MM' + NN') : \sqrt{(L^2+M^2+N^2)(L'^2+M'^2+N'^2)},$$

whence the lines are parallel if and only if $L:L' = M:M' = N:N'$, and are perpendicular if and only if $LL'+MM'+NN'=0$. The angle θ between a line of direction-cosines proportional to L, M, N and a plane

$$Ax+By+Cz+D=0$$

is given by the relation

$$\sin\theta = (AL+BM+CN) : \sqrt{(A^2+B^2+C^2)(L^2+M^2+N^2)},$$

whence the line and plane are parallel if and only if $AL+BM+CN=0$ and are perpendicular if and only if $A:L=B:M=C:N$. The necessary and sufficient condition that the line $x=m_1z+p_1$, $y=n_1z+q_1$, shall intersect the line $x=m_2z+p_2$, $y=n_2z+q_2$, is that $(m_1-m_2):(n_1-n_2) = (p_1-p_2):(q_1-q_2)$.

The literature of the analytical geometry of space, herewith barely introduced, is extensive. For some account of further developments of the subject, see the articles SURFACES, THEORY OF, and CURVES OF DOUBLE CURVATURE, THEORY OF, in this Encyclopedia. In the doctrine above introduced the point is employed as element. Some account of the theories that arise on choosing for element some other geometric entity, as the plane, the line, the sphere, etc., may be found in the articles, GEOMETRY, MODERN ANALYTICAL, and GEOMETRY, LINE, AND ALLIED THEORIES, in this work.

Bibliography.—College text-books of analytical geometry abound. One of the scientifically best American texts is W. B. Smith's 'Coordinate Geometry.' The most comprehensive English works are Salmon's 'Conic Sections' and 'Geometry of Three Dimensions' (both of which have been translated into French by O. Chemin, and supplemented and translated into German by Wilhelm Fiedler), and Frost's 'Solid Geometry.'

CASSIUS J. KEYSER,
Adrain Professor of Mathematics, Columbia University.

Geometry, Elementary. Geometry is the science of space. Its object is the study of the properties of forms (configurations, figures) of every conceivable kind. The subject is thus endless in two ways: in the first place, the number of configurations is infinite—this is so even if we restrict ourselves to curves and surfaces; in the second place, any one type of figure has an inexhaustible variety of properties.

Elementary geometry may be roughly described as the study of the simpler or more evident properties of the simpler configurations. Specifically, the title refers to the body of geometric truths incorporated by Euclid in his famous 'Elements.' The text-books on elementary geometry used throughout the civilized world for the last twenty centuries are in fact merely revisions of the 'Elements'; so that the subject itself is often referred to, especially in England, as the study of Euclid. The majority of the theorems refer to points, straight lines, and planes, with their combinations. Of curves, only the circle is considered, and of surfaces, those related to the circle (spherical, cylindrical, conical).

It is not the object of this article to give a résumé of the standard theorems of elementary geometry, but rather to indicate some of the more significant general features, especially in the light of the more recent developments.

LOGICAL FOUNDATIONS.

The most prominent aspect of elementary geometry is the logical aspect: a great number of propositions, termed theorems, are deduced from a comparatively few propositions assumed at the outset and termed axioms or postulates. In the ideal treatment of the subject, all the assumptions should be enumerated explicitly, so that, if the question is asked, «Are the theorems of geometry true,» the mathematician can answer correctly, «Yes, if my postulates are true.» As to whether the postulates are true, that is not a matter for the mathematician as such to consider, but rather comes within the province of the physicist, psychologist, or philosopher.

The ordinary course in geometry, modeled after Euclid, does not carry out this ideal. Assumptions are continually being made as they may be needed for the purpose of proof, in addition to those explicitly enunciated as axioms and postulates. For example, in the first proposition of Euclid, dealing with the construction of an equilateral triangle on a given segment AB, circles are drawn with centres A and B and common radius AB, and it is then assumed that these circles intersect. The only justification given is the diagram or the appeal to spatial intuition. Again, in dealing with the congruence of triangles, it is assumed that a triangle may be moved about without altering its sides or angles, though the stated axioms do not even mention displacement. In spite of himself, Euclid's treatment is (partly) physical or intuitional, instead of purely mathematical, that is, purely logical.

It is only within the last few years that the ideal has been (practically) attained; that is, a set of explicit assumptions (termed axioms or postulates indifferently) drawn up, from which the propositions of ordinary geometry follow by purely logical processes. Geometry becomes then a branch of pure mathematics. As Poincaré expresses it, in this ideal treatment «We might put the axioms into a reasoning apparatus like the logical machine of Stanley Jevons, and see all geometry come out of it.»

Many contributors have aided in this development, among whom may be mentioned Gauss, Lobachevsky, Pasch, Veronese, and especially Peano and his co-workers in symbolic logic, Pieri and Peano. The most elaborately worked out system is that of Hilbert (1900). We give a brief account of his axioms.

Geometry deals with three systems of objects or elements termed *points*, *lines* (used here in sense of straight lines), and *planes*, connected by certain relations expressed by the words *lying in*, *between*, etc. It is not necessary for the development of the subject that these words should suggest visual images; in fact the concrete nature of the elements and

relations is to be eliminated from the discussion. To emphasize this abstract aspect, it is convenient to use symbols, say capital letters for points, italics for lines, and Greek letters for planes. The axioms are arranged in five groups as follows:

I. *Axioms of Association or Connection.* — 1. Any two different points A, B determine a line a. (Such points are then said to lie on the line.)

2. Any two different points on a line determine that line.

3. In any line there are at least two points, and in a plane there are at least three points not on a line.

4. Any three non-collinear points A, B, C determine a plane α.

5. Three non-collinear points of a plane determine that plane.

6. If two points A, B of a line a are in a plane α, then every point of a is in α. (The line is then said to lie in the plane.)

7 Two planes α, β which have a point A in common have at least a second point B in common.

8. There exist at least four points not in one plane.

II. *Axioms of Order.*—These deal with the relation expressed by the term *between*.

1. If A, B, C are points of a line and B is between A and C, then B is between C and A.

2. If A and C are points of a line a, then there exists on a at least one point B between A and C, and at least one point D such that C is between A and D.

3. Of any three collinear points, one and only one is between the other two.

These three axioms deal with the line, while the fourth deals with the plane.

4. If A, B, C are any three non-collinear points, and a is a line in their plane passing through a point of the segment AB, but not through A or B or C, then a contains a point of either the segment AC or the segment BC.

III *Axioms of Congruence.*—The first five axioms of this group relate to congruent segments and congruent angles. For example, a segment AB is congruent to itself and to the reversed segment BA; and segments congruent to the same segments are congruent to each other. Finally, the sixth is a metrical axiom concerning triangles: if two sides and the included angle of one triangle are congruent respectively to two sides and the included angle of another triangle, then the remaining angles are also congruent.

The fact that the remaining sides are congruent is not included as a part of the axiom because it may be proved. The other cases of congruent triangles are theorems. In Euclid the above statement is a theorem, but this is possible, as already observed, merely on account of unstated assumptions relating to displacement. Euclid's axiom that all right angles are congruent, in Hilbert's system becomes a theorem.

IV. *The Axiom of Parallels*.—This contains only the so-called *Euclidean axiom*, in the form: Given a line a and a point A not on a, then in the plane α determined by a and α there is only one line through A which does not intersect a.

V. *Axioms of Continuity.*—The continuity notion is analyzed into two parts of which the first (1) is stated in the axiom of *Archimedes:* 1. On a straight line consider any two points A, B and a point A_1 between them; construct the points A_2, A_3, . . . , in order, so that A_1 is between A and A_2, A_2 between A_1 and A_3, etc., and so that the segments AA_1, A_1A_2, A_2A_3, . . . , are congruent; then among the points so constructed there exists a point A_n such that B is between A and A_n. That is, by repeatedly laying off a given segment however small any assigned point of the line will be passed after a finite number of steps.

This axiom is sufficient for the development of the usual theorems of geometry. However the space to which the theorems apply would not be continuous in ordinary sense. It would in fact contain only those points of the space considered in analytical geometry whose coordinates are rational or expressible by radicals of the second order. To identify with continuous space it is necessary to add a final axiom (2) relating to convergent point sets, or else the so-called axiom of completeness which states that the system of elements (points, lines, planes) cannot be enlarged by adjoining other elements in such a way that all the previous axioms are preserved.

The fact that this set of axioms is sufficient is shown by actually deducing the usual body of theorems. This is done in Hilbert's 'Grundlagen.' Diagrams are here used, it is true, but only for convenience; the proofs can be given without any reference to the diagrams. Often the deduction of those results which are evident to the intuition is long and complicated. This is the case, for example, in showing that a triangle (or any simple polygon) has the properties expressed by the terms inside and outside. It must be shown from the axioms that the given triangle brings about a division of the points in its plane into three classes, namely, points P, points I, and points O, such that any two I points or any two O points may be connected by a broken line not containing any P point, while any broken line from an I point to an O point necessarily contains P points. To the intuition, of course, the P points are the points on the perimeter of the triangle, the I points are those inside, and the P points are those outside.

In the development it is important to observe that some theorems depend upon only part of the axioms. Thus from group I alone it follows that two planes having a point in common necessarily have a line in common, and that a line and a point determine a plane. The property of triangles and polygons stated above follows from group I and II. The theory of proportion may be established without employing group V. The theorem that if two triangles in one plane have their sides respectively parallel, the lines joining corresponding vertices are either parallel or concurrent (a special case of *Desargues'* theorem), can be proved without using axiom III 6 if and only if the spatial axioms in addition to the plane axioms are employed.

An important result which has been obtained recently is that while the areas of plane polygons may be treated without appealing to the continuity axioms, this is not possible with the volumes of polyhedrons. The difference is observed in Euclid's proofs: the

proposition that triangles having the same base and altitude are equal in area is demonstrated by adding or taking away congruent parts from congruent figures, while the corresponding proposition concerning triangular pyramids is proved by the method of limits, or the equivalent method of exhaustion. That this difference in treatment is not avoidable was established by Dehn (1901), who showed that there exist polyhedrons of equal volumes which cannot be formed by the addition or subtraction of respectively congruent polyhedrons. In plane geometry this formation applies to any two polygons with the same area.

The most fundamental question concerning the set of axioms is that of *consistency*. In the development of geometry no contradiction has thus far presented itself; but will this always be the caes? Can it be shown that no inconsistency can ever arise? The only known method of answering this question depends upon establishing a correspondence between the geometrical elements and certain numerical entities, and showing that any inherent contradiction in geometry would involve contradictory relations among these entities. The question is thus transferred to the field of Arithmetic. Are the axioms of number (commutative, associative, distributive, etc.) inconsistent? No direct proof has yet been devised.

Another question to be considered is the independence of the axioms. If any one axiom can be deduced from the others, it may be omitted from the list and introduced as a theorem. It is therefore desirable that the axioms should express mutually independent statements. The standard method employed in proving the independence of an axiom or group of axioms consists in devising a set of objects of any kind which, when considered as elements, fulfill the relations expressed in remaining axioms, but for which the axiom or group in question is not satisfied. Thus the fact that the axiom of parallels (IV) cannot be deduced from the other axioms is shown by the non-Euclidean geometry of Lobachevsky. Similarly, the independence of axiom VI is proved by means of the non-Archimedean geometries of Veronese and Hilbert. Various apparently artificial systems have been devised in this connection, which, while not amenable to the intuition, are conceivable and mathematically true because based on assumptions which may be shown to be free from inconsistency.

The set of axioms presented above is of course not the only one which may serve as foundation for ordinary geometry. Thus the axiom of parallels may be replaced by the statement that the sum of the angles of a triangle is two right angles. In general the propositions of a given collection may be derived from various sets selected from the total collection. In the present case the possibilities are endless.

Geometry may also be founded on other primitive (undefined) concepts than those introduced above. Thus in the discussions inaugurated by Helmholtz and continued by Lie and Poincaré, the principal concept is that of transformation (displacement, rigid motion) and the axioms include the group property (the resultant of two displacements is itself a displacement). The straight line is then no longer, as in Hilbert's system, a primitive concept, but receives definition: if in a displacement two points are fixed, there are an infinite number of fixed points forming, by definition, a straight line (the axis of rotation).

In the usual intuitional treatment the concept of general surface is assumed as a starting-point and the plane is then defined as a surface such that if any two of its points are joined by a straight line, the latter lies entirely in the surface. This obviously states more than is required for the determination of the surface. To meet this objection the plane is sometimes defined as generated by drawing straight lines from a fixed point A to all the points of a straight line a. To obtain the entire plane it is necessary to add the line through A parallel to a. This definition is therefore unsatisfactory, because parallel lines require in their definition the previous definition of the plane. Peano has met the difficulty by this definition: Consider three fixed points A, B, C not in a straight line; take a fixed point D within the segment BC, and on the segment AD take a fixed point E; a plane is then generated by the lines (rays) from E to every point of the perimeter ABC. It may then be proved that a straight line connecting any two points of such a surface lies on the surface.

Problems and Constructions.

The only instruments whose use is implied in the postulates of elementary geometry are the ruler (straight-edge), for drawing straight lines, and the compass, for drawing circles. Only those problems are considered as coming within the domain of elementary geometry which can be solved by a finite number of operations with these instruments. Such constructions are termed *Euclidean*, or sometimes simply *geometric*. An example is the construction for bisecting an angle. With the vertex V as centre and any radius describe a circle cutting the sides of the angle in points A and B; with these points as centres and any (sufficiently large) radius describe circles intersecting in points C and D; the line joining C and D necessarily passes through V and bisects the given angle.

However, many problems arise which cannot be solved in this way. A well-known example is the problem of trisecting an angle. For centuries the Greek geometers and their followers sought for a solution; only within the present century has it been shown that such attempts must necessarily fail. The statement that the problem is impossible does not deny that lines trisecting the given angle exist, but means simply that such lines cannot be obtained by a construction employing a finite number of straight lines and circles.

No one has yet succeeded in demonstrating this impossibility by purely geometric means. The question arises naturally in elementary geometry, but apparently cannot be answered by elementary methods. We give now an outline of the algebraic method for deciding whether a given problem comes within the class of possible or the class of impossible problems.

Any line segment may be represented by a segment, namely, the ratio of the given seg-

ment to an assumed unit segment. Conversely, any number then represents a segment. Consider now the elementary operations of arithmetic or algebra in relation to geometric constructions.

If a and b denote given segments, or the corresponding numbers, the sum $a+b$ is constructed by transferring the segment b, by means of the compass, so that it is collinear and adjacent to a. The difference $a-b$ is also readily constructible.

The product $x=ab$ may be defined by the proportion $1:a=b:x$. The proper construction is then suggested by the theorem that a line parallel to the base of a triangle divides the sides proportionally. Draw any triangle with 1 and a as two of the sides; along the first side prolonged if necessary lay off segment b; from the terminal point draw a line parallel to the base of the triangle; this cuts off on the second side a segment equal to the required x. The quotient $y=a/b$ is obtained similarly from the proportion $b:1=a:y$. Hence all rational expressions, that is, expressions formed by a finite number of additions, subtractions, multiplications, and divisions are constructible.

Furthermore, extraction of square roots is possible. For $z=\sqrt{a}$ may be defined by $1:z=z:a$. Hence if on $1+a$ as diameter a semicircle is described, the perpendicular at the end of the unit segment is the required z. Therefore,

Theorem I.—Any expression involving only rational operations and the extraction of square roots can be constructed with ruler and compass.

Expressions which cannot be reduced to this form cannot be constructed. This we now prove in the form of the converse:

Theorem II.—Any segment which can be constructed with ruler and compass is expressible algebraically by rational operations and the extraction of square roots.

For any such construction consists in drawing a finite number of straight lines and circles and finding their intersections. Employing Cartesian coordinates (see GEOMETRY, CARTESIAN), the equation of a straight line is of the form $ax+by+c=0$, and that of a circle is of the form $x^2+y^2+ax+by+c=0$. The intersection of two straight lines leads to the solution of two equations of the first degree, which requires only rational operations. The intersections of a straight line and circle, or of two circles, depends on the solution of quadratic equations and leads to radicals of the second degree.

We proceed to apply these theorems to several examples.

Consider first the problem of bisecting an angle. The given angle θ and the required angle $\frac{\theta}{2}$ may be determined by their cosines.

Let $a=\cos\theta$ and $x=\cos\frac{\theta}{2}$ From trigonometry $\cos\theta=2\cos^2\frac{\theta}{2}-1$, that is, $2x^2-1=a$. Hence $x=\sqrt{\frac{1+a}{2}}$. Therefore, by Theorem I, the problem is elementary. The formula also indicates a definite method of construction.

In the *trisection* of a given angle we require the formula $\cos\theta=4\cos^3\frac{\theta}{3}-3\cos\frac{\theta}{3}$. Here $\cos\theta=a$ is known, and $\cos\frac{\theta}{3}=x$ is required. The equation of the problem is

$$4x^3-3x-a=0.$$

When solved by Cardan's formula this leads to cube roots. But before Theorem II can be applied it must be shown that no expression involving only square roots can satisfy the equation. This is true in the present case by the following general theorem taken from the theory of equations:

Theorem III.—An irreducible equation whose degree is not a power of two cannot have a root expressible by radicals of the second degree. (The term irreducible equation is here employed to describe an equation $f(x)=0$ with rational coefficients whose left member cannot be factored rationally.)

In general the algebraic questions which arise in this connection require for their complete discussion the powerful Galois Theory of Equations. See EQUATIONS, GALOIS' THEORY OF.

A second of the so-called famous problems of elementary geometry is the *Delian problem*, or the duplication of the cube. Given a cube with side a, to construct a cube with side x having double the volume. The equation of the problem is $x^3=2a^3$. Theorem III and then Theorem II apply. The corresponding problem concerning the square, leading to the equation $x^2=2a^2$, is easily solved: the side of the required square is simply the diagonal of the given square.

Regular Polygons.—The construction of a regular polygon of n sides is equivalent to the division of a given circumference into n equal arcs. The only cases treated by Greek geometers and the ordinary text-books are, for prime numbers, $n=3$ and $n=5$; from these constructions of the regular triangle and pentagon, combined with the construction for bisecting an angle, the constructions for the cases 2^κ, $3\cdot 2^\kappa$, $5\cdot 2^\kappa$, $3\cdot 5\cdot 2^\kappa$, where κ is any integer, are easily found.

No advance was made, that is, no new constructible polygons were discovered, until Gauss, about a century ago, applied the algebraic method. The equation of the problem may be put into the form

$$x^{n-1}+x^{n-2}+\ldots+x+1=0,$$

which is then termed the *cyclotomic equation*. When n is a prime number the equation is irreducible. Hence by Theorem III the construction is possible only when $n-1$ is a power of 2. That is, n must be of the form $2^\mu+1$. Prime numbers of this type are necessarily of the form $2^{2^\nu}+1$, and are known as *Fermat primes*. The values $\nu=0$ and $\nu=1$ give the familiar cases $n=3$ and $n=5$; the first new case, arising from $\nu=2$, is $n=17$. The construction for the regular polygon of 17 sides is complicated, but the steps are indicated definitely by the algebraic solution of the cyclotomic equation, which is in fact solvable by square roots.

The general result on regular polygons is as follows; The regular polygon of n sides

can be constructed with ruler and compass if, and only if, the prime factors of n are 2 repeated any number of times and distinct Fermat primes.

The first impossible cases are $n=7$ and $n=9$.

Quadrature of the Circle.—This most famous problem of geometry requires the construction of a square having the same area as a given circle. That this is impossible (that is, that the construction cannot be effected with the ruler and compass) was not definitely shown until 1882, although the failure of innumerable attempts had led many to suspect the true result. The *rectification* of the circle, that is, the construction of a straight line having the same length as a given circumference, is an equivalent problem, and hence also impossible. This is so on account of the theorem that the area of a circle equals one half the product and the radius into the circumference.

The ratio of the circumference to the diameter is the same for all circles: the constant thus arising has been generally denoted by the symbol π since the time of Euler. It was proved, quite simply, by Legendre that π is not rational (i.e., cannot be represented exactly by the ratio of any two integers, and hence, in particular, cannot be represented by a terminating decimal). The difficulty consists in showing that π is *transcendental*, that is, is not the root of any algebraic equation

$$a_0x^n + a_1x^{n-1} + \ldots + a_n = 0,$$

where n is a positive integer, and the coefficients are any integers. This was finally proved by Lindemann in 1882, after Hermite in 1873 had shown that e, the base of the Napierian system of logarithms, is transcendental. The two numbers are connected by the remarkable relation $e^{i\pi} = -1$, where i is the imaginary unit number $\sqrt{-1}$. Since π cannot satisfy any algebraic equation, it certainly cannot be expressed by square roots. Hence Theorem II proves the impossibility.

Approximate Constructions.—The problems considered cannot be solved exactly by ruler and compass, but they can be solved to any required degree of approximation. Thus a simple approximate solution of the rectification problem is the following: Let O be the centre and AB any diameter of the given circle. At the middle point E of AO construct a perpendicular cutting the circumference in C and D. On AB prolonged lay off $EF = CD$. Draw FD, and on this line lay off $FH = AB$. Then the segment HD is approximately one fourth the circumference. The error is less than one part in 5000.

Other Instruments.—The problems considered may be solved exactly if other instruments in addition to ruler and compass are allowed. Thus the trisection and duplication problems (like all problems depending on cubic and biquadratic equations) can be solved by the instruments for drawing parabolas or other conics, or by appropriate linkages. The quadrature of the circle, being a transcendental problem, cannot be effected by any instrument which draws algebraic curves. It can be solved by various transcendental curves (quadratrix, sinusoid, cycloid); or by the integraph (an instrument which draws the curve $y = \int f(x)dx$, where $y = f(x)$ is a given curve).

We consider now various restrictions which may be imposed on Euclidean constructions.

(1) *Ruler Constructions.*—Here only the straight-edge is allowed. For the possibility of such a construction it is necessary but not sufficient that the corresponding algebraic expression should be rational. If two parallel lines are given, then through a given point a line may be drawn parallel to given lines by a ruler construction. But this is not the case when a line is to be drawn through a given point parallel to a given line. The impossibility proof, based upon projection, may be carried out by pure geometry.

(2) *Masheroni Constructions.*—Here only the compass is allowed. A straight line is considered as known when two of its points are determined. Masheroni, in 1797, showed that all problems which can be solved by the ruler and compass can be solved by the compass alone.

(3) Poncelet and Steiner have shown that, if a single fixed circle with its centre is given, all elementary constructions may be carried out by means of the straight-edge. Again, if a ruler with parallel edges may be employed (it is then, for instance, possible to place the instrument so that each edge goes through an assigned point), all elementary problems may be solved without the compass.

(4) Hilbert considers constructions with the straight-edge and *sect-carrier*. The latter denotes a compass used not to draw circles, but merely to lay off a given segment on a given line. All such constructions can be carried out by the straight-edge and a movable unit sect. The test for deciding the possibility or impossibility of a problem in this sense is exceedingly complicated, depending on the higher theory of algebraic numbers.

Geometrography.—A problem of elementary geometry can usually be solved in a variety of ways by the ruler and compass. Thus for the Apollonian problem (to construct a circle touching three given circles) over one hundred distinct solutions have been worked out (Apollonius, Poncelet, Steiner, Lemoine, Study, etc.). How can we compare these as regards simplicity? It is necessary to adopt some standard or measure of simplicity. One method, for instance, would be to take the number of lines and circles as the measure of simplicity.

A more complete (but still somewhat artificial) discussion has been elaborated by E. Lemoine in his 'Geometrography.' Constructions are analyzed into the following elementary operations: Operation C_1 consists in placing one point of the compass on a given point in the plane of construction; including a given length between the points of the compass is then denoted by $2C_1$; placing a point of the compass on an undetermined point of a line is operation C_2; drawing a circle is C_3; making the edge of the ruler pass through an assigned point is operation R_1, and through two assigned points is $2R_1$; finally, drawing a straight line is operation R_2. Any construction may then be represented by a symbol $l_1R_1 + l_2R_2 + m_1C_1 + m_2C_2 + m_3C_3$, where the coefficients represent the numbers of elementary operations involved. The *simplicity* is measured by $l_1 + l_2 + m_1 + m_2 + m_3$, and the *exactness* by $l_1 + m_2 + m_3$ (the preparatory operations). The number of lines employed is given by l_2 and of circles by m_3.

In the case of the construction for the bisection of an angle explained above the symbol is $3C_1+3C_3+2R_1+R_2$. The construction which leads to the smallest possible value for the *simplicity* is termed the geometrographic solution. There may be more than one solution of this kind.

Bibliography.—Casey, 'Sequel to Euclid' (Dublin 1,888; Euclid, 'Elements' (Editions by Hall and Stevens, Harper, Nixon, Todhunter, etc.); Hadamard, 'Leçons de géométrie élémentaire' (2 vols., Paris, 1898, 1901); Hilbert, 'Grundlagender Geometrie' (Leipizg, 1899, 2d edition, 1901); translation by Townsend (Chicago, 1900); Halsted, 'Rational Geometry' (New York, 1904); Kempe, 'How to draw a straight line' (London, 1877); Klein, 'Elementargeometrie' (Leipzig, 1895); translation by Beman and Smith (Boston, 1897); Phillips and Fisher, 'Elements of Geometrie' (New York, 1896); Vahlen, 'Abstracte Geometrie' (Leipzig, 1905); Legendre, 'Eléments de géométrie' (Paris, 1794); Lindemann, 'Ueber die Zahl π' (Mathematische Annalen, vol. 20, 1882).

EDWARD KASNER,
Instructor in Mathematics, Columbia University.

Geometry, Line-, and Allied Theories.—For geometric purposes space may be conceived in an endless variety of ways (see CARTESIAN GEOMETRY), *i.e.*, as the manifold of all the geometric entities of *any* given kind contained in it. In particular, it may be viewed as the assemblage (manifold, aggregate, plenum) of its points or of its planes or of its lines. According as one or another of these views be adopted as fundamental, any configuration, as a curve or a surface, will present as fundamental the corresponding aspect, *i.e.*, it will appear as the *locus* (assemblage) of its points or as the *envelope* (assemblage) of its tangent planes or as the *envelope* (assemblage) of its tangent lines. These various views or aspects are not independent. Each involves the others, but they are not coordinate: one of them being assumed as fundamental or *primary*, the others appear as derived or *secondary*. Space accordingly admits of various geometric theories distinguished by and taking their names from their primary elements. Line-geometry contemplates space as primarily composed of lines, employs the line as fundamental element, and has for its subject-matter the relations and properties of line configurations. Thus the rôle of the right line in this doctrine is quite analogous to that of the point or the plane in the older geometries. The plane, too, has a line-geometry (see GEOMETRY, MODERN ANALYTICAL), but the line and the point theories of the plane, being analytically identical, are best treated simultaneously as dual aspects of a single doctrine.

The honor of having been the first to make formal and systematic use of the right line as primary element in the geometry of space belongs to Julius Plücker (1801–1868), whose 'Neue Geometrie des Raumes gegründet auf die Betrachtung der geraden Linie als Raumelement,' 1868–69, is the first great contribution to the subject. The idea of employing the line as space element had indeed occurred to him at a much earlier date. (Cf. his 'System der Geometrie des Raumes,' 1846.) His first memoir on the subject, entitled 'On a New Geometry of Space,' was published in English in 1865 and may be found in vol. 14 of 'The Proceedings of the Royal Society of London' and elsewhere. Certain important line systems, as congruences and complexes (names given by Plücker), had indeed been previously studied to some extent by others. The notion of congruences of lines naturally first presented itself in geometric researches in optics, and in fact the first appearance of the concept of the line complex seems to be that found in the 'Traité d'Optique' of the physicist, Étienne Louis Malus (1775–1812). The point-plane and line-line correlations or null-systems established by the linear complex were considered in 1827 by the Italian geometrician Giorgini (('Memorie dei XL.,' vol. 20), and in 1833 by Moebius in a memoir entitled 'Über eine besondere Art dualer Verhältnisse zwischen Figuren im Raume' ('Crelle's Journal,' vol. 9–10). Nevertheless the invention of the line geometry of space is, as said, to be properly ascribed to Plücker. His work in this field is the beginning of a great epoch in the science of analytical geometry. The undying influence of that work is due neither to its content nor, strictly speaking, to its method, important as these are. It is rather due to its spirit, which is the spirit of freedom, emancipating alike from traditional concepts and traditional modes of procedure. Since Plücker's time the science begun by him has been greatly refined and vastly extended, and out of it have come great and growing kindred doctrines, as the sphere and the circle geometries of space, and allied theories in spaces of higher dimensionality. The following paragraphs present a brief account of the elements of some of these theories, especially of line geometry, together with some indications of further developments and references to the corresponding literature.

Line Coordinates.—In Cartesian coordinates (see GEOMETRY, CARTESIAN) the line is determined by any pair of its projecting planes, *e.g.*, by the pair $x=rz+\rho$, $y=sz+\sigma$; conversely, any such pair determines a line. Accordingly the position of the line depends upon four independent quantities or *coordinates*, r, s, σ, ρ; the line has four degrees of freedom, space contains a fourfold infinity, ∞^4, of lines; in lines it is 4-dimensional: a being who thought in lines as «naturally» as man thinks in points would regard (our) space as having four instead of three dimensions. Linear transformation of Cartesian coordinates converts the line coordinates r, s, σ, ρ into the coordinates r', s', σ', ρ' (of the same line) where these are fractions whose terms are linear functions of r, s, σ, ρ, and $r\sigma-s\rho$; and, accordingly, an equation of degree n in r, s, σ, ρ is converted into one of degree $2n$ in those quantities. In order that the new and the old equations should be of the same degree in the old coordinates, Plücker introduced a fifth coordinate η, where $\eta=r\sigma-s\rho$. There are numerous other systems of line coordinates, and in his above-cited first paper Plücker himself presents no less than eight distinct systems. Of all the systems those that are *homogeneous* are at once the most artistic and convenient. These naturally present themselves as follows: If x_i and ξ_i $(i=1, 2, 3, 4)$ denote respectively the homogeneous coordinates (see GEOMETRY, MODERN ANALYTICAL) of a point and a plane referred to a fundamental tetraedron, then the equation $\xi_1x_1+\xi_2x_2+\xi_3x_3+\xi_4x_4=0$, or $\Sigma\xi_ix_i=0$, will

serve to represent the plane ξ_i (as locus of points) or the point x_i (as envelope of planes). It is at the same time the condition that the point x_i and the plane ξ_i shall be united in position, each containing the other. The line determined by two planes ξ_i and η_i is represented by the pair of equations $\Sigma\xi_i x_i=0$, $\Sigma\eta_i x_i=0$. It is equally determined by any two planes of the axal pencil $\Sigma(\xi_i+\lambda\eta_i)x_i=0$. Of these the simplest are the four of which each contains a vertex of the tetraedron of reference. Their equations are

$$\begin{aligned}
* \quad + q_{12}x_2 + q_{13}x_3 + q_{14}x_4 &= 0,\\
q_{21}x_1 + \quad * \quad + q_{23}x_3 + q_{24}x_4 &= 0,\\
q_{31}x_1 + q_{32}x_2 + \quad * \quad + q_{34}x_4 &= 0,\\
q_{41}x_1 + q_{42}x_2 + q_{43}x_3 + \quad * \quad &= 0,
\end{aligned}$$

where $\rho q_{jk}=\xi_j\eta_k-\xi_k\eta_j$, ρ being a proportionality factor; *e.g.*, $\rho q_{12}=\xi_1\eta_2-\xi_2\eta_1$. As $q_{jk}=-q_{jk}$, there are but six numerically distinct coefficients q. These are connected by the quadratic identity $q_{12}q_{34}+q_{13}q_{42}+q_{14}q_{23}=0$; as, moreover, only their ratios are essential, the six q's are equivalent to but four independents. Accordingly the q's may be, and for the sake of symmetry are, adopted as *six homogeneous coordinates of the line regarded as the axis* (*envelope*) *of a pencil of planes.*

The line has another aspect; it may be viewed as locus of its points, determined by any pair of them as x_i and y_i. So viewed, it is represented by the pair of point equations $\Sigma x_i\xi_i=0$, $\Sigma y_i\xi_i=0$. The line is equally determined by any two points of the range $\Sigma(x_i+\lambda y_i)\xi_i=0$ and in particular by any two of the four points in which the line pierces the faces (planes) of the fundamental tetraedron. Of these points the equations are

$$\begin{aligned}
* \quad + p_{12}\xi_2 + p_{13}\xi_3 + p_{14}\xi_4 &= 0,\\
p_{21}\xi_1 + \quad * \quad + p_{23}\xi_3 + p_{24}\xi_4 &= 0,\\
p_{31}\xi_1 + p_{32}\xi_2 + \quad * \quad + p_{34}\xi_4 &= 0,\\
p_{41}\xi_1 + p_{42}\xi_2 + p_{43}\xi_3 + \quad * \quad &= 0,
\end{aligned}$$

where $\sigma p_{kj}=x_jy_k-x_ky_j$. The six p's satisfy an identity like that of the q's, the ratios of the p's are alone important, and, again with a view to symmetry, the p's are chosen as the *six homogeneous coordinates of the line conceived as a locus* (*range*) *of points.*

It is readily found that the line p_{jk} and the line q_{jk} are one and the same when and only when $p_{12}:q_{34}=p_{13}:q_{42}=p_{14}:q_{23}=p_{34}:q_{12}=p_{42}:q_{13}=p_{23}:q_{14}$. Accordingly, disregarding both the locus and envelope aspects of the line, we may employ for its coordinates any six quantities r_{jk} which, ρ and σ being proportionality factors, satisfy the relations: $r_{12}=\rho q_{12}=\sigma p_{34}$, $r_{13}=\rho q_{13}=\sigma p_{42}$, $r_{14}=\rho q_{14}=\sigma p_{23}$, $r_{34}=\rho q_{34}=\sigma p_{12}$, $r_{42}=\rho q_{42}=\sigma p_{13}$, $r_{23}=\rho q_{23}=\sigma p_{14}$. The identity connecting the r's may be written (after Koenigs) $\omega(r)=2(r_{12}r_{34}+r_{13}r_{42}+r_{14}r_{23})=0$.

Passing from homogeneous to Cartesian point coordinates, *i.e.*, from a finite tetraedron to an infinite one having three of its faces mutually perpendicular and for the fourth the plane at ∞, there result the six homogeneous line coordinates employed by Plücker. The transition is effected by substituting x', y', z', 1 respectively for x_1, x_2, x_3, x_4, and x'', y'', z'', 1 for y_1, y_2, y_3, y_4; the Plücker coordinates accordingly are:

$p_{12}=x'y''-x''y'$, $p_{13}=x'z''-x''z'$, $p_{23}=y'z''-y''z'$, $p_{14}=x'-x''$, $p_{42}=y''-y'$, $p_{34}=z'-z''$.

If we replace x'', ... by $x'+dx'$, ..., *i.e.*, if we regard the line as determined by consecutive (neighboring, infinitely near) points, the Plücker coordinates assume the form adopted by Sophus Lie. The primes being omitted, the Lie line coordinates are: $p_{12}=xdy-ydx$, $p_{13}=xdz-zdx$, $p_{23}=ydz-zdy$, $p_{14}=-dx$, $p_{42}=dy$, $p_{34}=-dz$.

The general coordinates r_{jk} admit of further generalization. They may be replaced by linear functions of them; *i.e.*, if $r_{jk}=C_{jk\cdot 1}v_1+C_{jk\cdot 2}v_2+\dots+C_{jk\cdot 6}v_6$, where the determinant of the C's does not vanish, the six variables v_i may be employed as line coordinates. The v's satisfy a quadratic identity $\xi(v)=0$, into which $\omega(r)=0$ is converted by the foregoing transformation. A simple special case of this transformation yields an elegant system of line coordinates introduced by Felix Klein. Replacing the v's by x's, the special transformation is: $x_1=r_{12}+r_{34}$, $ix_2=r_{12}-r_{34}$; $x_3=r_{13}+r_{42}$, $ix_4=r_{13}-r_{42}$; $x_5=r_{14}+r_{23}$, $ix_6=r_{14}-r_{23}$; where $i=\sqrt{-1}$. The Kleinian line coordinates are x_j ($j=1,\dots,6$). The identity connecting them is $\Sigma x_j^2=0$.

Condition of Intersection of Lines.—The two lines may be conceived as loci, or as axes, or one as a locus and the other as an axis. In the first case, suppose the lines are determined respectively by the point pairs (x_i, y_i), (x'_i, y'_i). The lines p and p' will intersect when and only when the four points lie in a plane, for which the necessary and sufficient condition is

$$\begin{vmatrix} x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ x_1' & x_2' & x_3' & x_4' \\ y_1' & y_2' & y_3' & y_4' \end{vmatrix}=0,$$

which on expansion yields $p_{12}p'_{34}+p_{13}p'_{42}+p_{14}p'_{23}+p_{34}p'_{12}+p_{42}p'_{13}+p_{23}p'_{14}=0$. Of this condition the first member is

$$\frac{1}{2}\left[\frac{\partial\omega(p)}{\partial p_{12}}p'_{12}+\dots+\frac{\partial\omega(p)}{\partial p_{42}}p'_{42}\right]$$
$$\equiv\frac{1}{2}\left[\frac{\partial\omega(p')}{\partial p'_{12}}p_{12}+\dots+\frac{\partial\omega(p')}{\partial p'_{42}}p_{42}\right].$$

Denoting this *polar* form by $\omega(p, p')$, the condition that the two lines (loci, point ranges) p and p' shall have a common point is $\omega(p,p')=0$. In like manner, the condition that the lines (envelopes, axal pencils of planes) q and q' shall have a common plane is $\omega(q,q')=0$. If one of the lines be regarded as a locus, the other as an envelope, the condition of intersection is $\Sigma p_{jk}q'_{jk}=0$ or $\Sigma q_{jk}p'_{jk}=0$. Disregarding the aspects of the lines r and r', the condition is $\omega(r,r')=0$. The preceding transformation from r's to v's converts $\omega(r,r')$ into $\xi(v,v')$, where $2\xi(v,v')=\frac{\partial\xi}{\partial v_1}v_1'+\dots+\frac{\partial\xi}{\partial v_6}v_6'$. Hence the condition that the lines v, v' shall intersect is $\xi(v,v')=0$. In Klein coordinates, the condition for the intersection of the lines x and x' is $\Sigma x_jx_j'=0$ ($j=1,\dots 6$).

Pencils and Hyperpencils.—Let v' and v'' be any two intersecting lines. These determine a flat pencil, *viz.*, that whose vertex is the common point of v' and v'' and whose lines

lie in the plane of v' and v''. All and only the coordinates of the lines of the pencil are given by the formula $v_i = \lambda v_i' + \mu v_i''$. For, first, $\xi(v) = \xi(v')\lambda^2 + 2\xi(v', v'')\lambda\mu + \xi(v'')\mu^2$, and, by hypothesis, $\xi(v') = 0$, $\xi(v'') = 0$, $\xi(v', v'') = 0$; hence $\xi(v) = 0$, and v_i represents a line for all values of the parameters λ and μ. Secondly, if v_i''' be *any* line cutting v' and v'', $\xi(v', v''') = 0$, $\xi(v'', v''') = 0$; hence $\xi(v, v''') = 0$, for $\xi(v, v''') = \lambda\xi(v', v''') + \mu\xi(v'', v''')$; therefore the lines v_i belong to the pencil. Thirdly, these are *all* of the lines of the pencil, for it is easily proved that the ratio, $\lambda:\mu$, can be determined so that the corresponding v_i shall cut *any* given line not contained in the plane of the pencil,

Koenigs has suggested the name hyperpencil (*hyperfaisceau*) to denote alike the totality of lines of a plane and the totality (sheaf, bundle) of lines through a point. A hyperpencil is determined by any three lines (not in a same pencil) of which each intersects the other two. If three such lines be v_i', v_i'', v_i''', then all and only the coordinates of the hyperpencil are given by the formula $v_i = \lambda v_i' + \mu v_i'' + \nu v_i'''$, λ, μ, ν being parameters. The hyperpencil will be a sheaf or a plane of lines according as the given lines determine but one point or three points.

Line Systems in General.—Just as, for example, in ordinary analytical geometry, we study systems (loci) of points represented by equations in point coordinates, so in the present subject we are concerned with line systems represented by equations in line coordinates. The line, we have seen, depends on four independent variables, coordinates, or *parameters.* The totality of lines in space may be called the 4-parameter system; it contains ∞^4 lines, a line in it has four degrees of freedom, one degree for each of the free (unconditioned) parameters or coordinates. One condition on the four parameters renders them equivalent to but three independent ones; hence the lines represented by one equation constitute a 3-parameter system, called by Plücker a line *complex.* A complex contains ∞^3 lines, a line in a complex has but three degrees of freedom. A 2-parameter system or *congruence* (Plücker), containing ∞^2 lines, allowing the line two degrees of freedom, is defined by a pair of equations. A triplet of equations represents a 1-parameter system, a ruled surface, or, better, a *line series* (*Série réglée*, Koenigs); it contains ∞^1 lines; in such a system the line has but one degree of freedom. Finally, a 0-parameter system, defined by four simultaneous equations, contains but a *finite* number of lines. In order, then, that five or more equations should represent a common system of lines, it is necessary that their coefficients satisfy some condition or conditions.

The Linear Complex.—The complex defined by an equation of degree n is said to be of nth degree. If $n = 1$, the complex is called *linear.* The general equation of the linear complex is $c_1v_1 + c_2v_2 + \ldots + c_6v_6 = 0$, or, briefly, $\Sigma c_j v_j = 0$, where $\xi(v) = 0$. How are the lines distributed? Let $v_i = \lambda v_i' + \mu v_i'' + \nu v_i'''$ be an arbitrary hyperpencil. In order that a line of the hyperpencil shall belong to the complex, it is necessary and sufficient that $\Sigma(\lambda v_i' + \mu v_i'' + \nu v_i''') = 0$, a single linear condition on the (two independent) ratios $\lambda:\mu:\nu$. Hence a single infinity of the lines of the hyperpencil belong to the complex. For if $u_i' = \lambda_1 v_i + \mu_1 v_i'' + \nu_1 v_i'''$ and $u_i'' = \lambda_2 v_i'' + \mu_2 v_i'' + \nu_2 v_i'''$ be any two of them, then plainly all lines of the pencil (u', u'') belong to the complex. On the other hand, no other line u''' does so belong, for, if it did, then every pencil determined by u''' and the lines of (u', u''), *i.e.*, all lines of the hyperpencil, would belong to the complex. Hence the proposition: *The lines of a linear complex are so distributed that every hyperpencil in space contains a pencil of lines (and no other line) belonging to the complex.* These pencils are called the pencils of the complex. The proposition admits of various equivalent statements of which one of the most illuminating is: *Given a linear complex, each point of space is the vertex of a pencil of lines of the complex and contains no other line of it; in each plane there is a pencil of lines (but no other line) of the complex.* In the former case the plane containing the pencil of the point is called the *polar* (plane) of the point; in the latter, the vertex of the pencil in the plane is called the *pole* (point) of the plane. Thus a linear complex serves to pair the points and planes of space as poles and polars, any pole and its polar being united in position. If a point P and a plane π be united in position, the pole P' of π and the polar π' of P are also united. Not only, however, are points and planes paired, but lines are paired with lines. The line common to two poles corresponds to the line common to their polars. Two such corresponding lines are called *conjugates* with respect to the complex. To a range of points (poles) corresponds an axal pencil of planes (polars), the base of the range and the axis of the pencil being conjugate lines. A line cutting two conjugates belongs to the complex, and all lines of the complex that cut a given line cut its conjugate also. If two lines intersect, so do their conjugates. Every line of the complex is its own conjugate, self-conjugate, and conversely. If a point moves along a line of the complex, the polar plane turns about the same line. This is a special case of the proposition that if a point glides along any line, the polar plane rotates about the conjugate line. Hence if P_1, P_2, P_3, P_4 be any four positions of the moving point and if π_1, π_2, π_3, π_4 are the corresponding planes, then the anharmonic ratios are equal, *i.e.*, $(P_1P_2P_3P_4) = (\pi_1\pi_2\pi_3\pi_4)$. In general: if C denote any configuration of points, lines, and planes, the polars, conjugates, and poles (with respect to a given complex) constitute a configuration C'. C and C' are called *reciprocal* configurations. The points, lines, and planes of either correspond uniquely and respectively to the planes, lines, and points of the other. In particular, if C is a polyedron, so is C'. The edges of either are conjugates of the edges of the other; the vertices and faces of either are respectively the poles and polars of the faces and vertices of the other. The vertices of either lie in the (polar) faces of the other.

Invariant of Complex, Special Complex, Directrix.—The condition,

$$2\xi(v, v') \equiv \frac{\partial\xi}{\partial v_1'}v_1 + \ldots + \frac{\partial\xi}{\partial v_6'}v_6 = 0,$$

that the line v shall intersect the line v', represents a *special* complex, viz., that of which all the lines cut a given line v', called

the *directrix* of the complex. The complex $\Sigma c_j v_j = 0$ is, then, special when and only when $\frac{\partial\xi}{\partial v_1'}:\frac{\partial\xi}{\partial v_2'}:\ldots:\frac{\partial\xi}{\partial v_6'}=c_1:c_2:\ldots:c_6$. These equations yield the values of (the ratios of) the v_j' in terms of the c_j. Substituting those values in $\xi(v')$, there results a homogeneous quadratic $\Omega(c)$, so that $\xi(v')=\Omega(c)$. Hence $\Omega(c)=0$ when and only when $\xi(v')=0$; hence the necessary and sufficient condition that $\Sigma c_j v_j = 0$ shall represent a special complex is that $\Omega(c)=0$. In such case the coordinates of the directrix are the coefficients c_j. The expression $\Omega(c)$ has been named by Klein the *invariant of the complex* $\Sigma c_j v_j = 0$. The complex is, therefore, special or non-special according as its invariant vanishes or does not. If $\xi(v)$ be reduced to the Plücker type $\omega(v) = 2(v_1v_4+v_2v_5+v_3v_6)$, the invariant assumes the form $\Omega(c)=2(c_1c_4+c_2c_5+c_3c_6)$. In case the above-mentioned Klein coordinates are employed, the form of the invariant is $-\Omega(c)=\Sigma c^2_j$ $(j=1, \ldots, 6)$.

Pencil of Complexes, and Line Congruence.—The system of lines *common* to two complexes is named line *congruence*. It is plain that the lines of the congruence determined by two complexes $\Sigma c_j v_j = 0$ and $\Sigma c_j' v_j = 0$ are common to the complexes of the pencil $\lambda\Sigma c_j v_j + \mu\Sigma c_j' v_j = \Sigma(\lambda c_j + \mu c_j')v_j = 0$ of complexes and that the congruence is equally determined by any two complexes of the pencil. Does the pencil include special complexes? If so, how many? The condition, $\Omega(\lambda c+\mu c')=0$, for special complexes, is quadratic in the ratio $\lambda:\mu$ of the parameters, and hence yields two values for that ratio, which may be real and distinct, real and equal, or imaginary. Accordingly, every pencil of complexes contains two and but two special complexes, real and distinct, coincident, or imaginary. The directrices of the special complexes are cut by all and only the lines of the congruence and are called the *directrices of the congruence*. Conversely, the assemblage of lines that intersect two given lines is a congruence. Hence a congruence is often defined to be the totality of lines intersecting two fixed lines. The directrices of a congruence are conjugate lines with respect to every complex of the corresponding pencil of complexes. In case the discriminant of the foregoing quadratic is zero, the directrices coincide. The (double) directrix is a line of the congruence. That discriminant is called the *invariant of the congruence*. The vanishing of the invariant signifies coincidence of the two special complexes and of their directrices. It may happen that the quadratic is identically zero. Then all complexes of the pencil are special, and the directrices constitute a pencil of lines.

Angle of Complexes; Involution.—Let a, b, c, d be any four values of the parameter $\lambda:\mu$ of the above pencil of complexes. The anharmonic ratio $(abcd)$ may be called the anharmonic ratio of the four corresponding complexes. If l be a line of the congruence, π a plane of l, and P_1, P_2, P_3, P_4 be the poles of π as to the complexes a, b, c, d respectively, then the anharmonic ratio $(P_1P_2P_3P_4)=(abcd)$. Also, if π_1, π_2, π_3, π_4 are the polar planes of a point P of l with respect to the four complexes, then $(\pi_1\pi_2\pi_3\pi_4)=(abcd)$. Hence $(\pi_1\pi_2\pi_3\pi_4)=(P_1P_2P_3P_4)$, and these equal ratios remain *constant* as π rotates about (P glides along) l and also as l varies its position in the congruence. We may suppose that b and d correspond to the *special* complexes of the pencil, and denote by F and F' the points common to l and the directrices, and by ϕ and ϕ' the planes determined by l and the directrices. Then $(P_1FP_2F')=(abcd)=(\pi_1\phi\pi_2\phi')$. Denote this anharmonic ratio by r. The corresponding angle, $A=(\log r):2\sqrt{-1}$, has been named by Klein the *angle of the complexes* a and c. If a and b be so taken (and that is possible) that $A=90°$, whence $r=-1$, then the two corresponding complexes are said to be *orthogonal* or *in involution*. The geometric significance of this relationship is that, when and only when it subsists between two complexes, each contains the conjugates of its lines with respect to the other. This subject of involution is intimately connected with the general doctrine of linear systems of linear complexes, but it cannot be further pursued here.

Hyperpencil of Complexes.—Such we may call the system $\Sigma(\lambda c_j+\mu c_j'+\nu c_j'')v_j=0$ determined by three independent complexes. $\Sigma c_j v_j=0$, $\Sigma c_j' v_j=0$, $\Sigma c_j'' v_j=0$. The name, system of three terms, is often employed instead of hyperpencil. The ∞^1 lines common to the three fundamental complexes are obviously common to all complexes of the hyperpencil. They constitute a ruled surface of second order. That the surface is of second order appears from the fact that the number of points in which it is pierced by a line u_j, *i.e.*, the number of solutions of the equations $\Sigma c_j v_j=\Sigma c_j' v_j=\Sigma c_j'' v_j=\xi(v)=\xi(v, u)$, is two. The surface is in general an *hyperboloid of one sheet;* in special case, a *hyperbolic paraboloid*. The lines constitute, however, but one system of generators. What of the other system? To answer, observe that the condition, $\Omega(\lambda c+\mu c'+\nu c'')=0$, that the hyperpencil shall contain special complexes, yields ∞^1 pairs of values of the (two independent) ratios $\lambda:\mu:\nu$. Hence the hyperpencil includes ∞^1 special complexes. The directrices of these constitute the second system of generators. These last are not lines common to the hyperpencil, on which account it seems better (after Koenigs) to call the lines common to the hyperpencil not a ruled surface, but a demi-quadric or series of lines.)

Complex of Higher Degree.—An equation $f_n(v)=0$ of degree n in line coordinates v_j defines a complex of degree n. Any line-pencil of space contains n lines of such a complex, so that the degree of a complex may be geometrically defined to be the number of lines common to the complex and an arbitrary pencil. The lines common to a complex of nth degree and a hyperpencil constitute a *cone* of *order* n if the hyperpencil is a *sheaf*, and envelope a plane *curve* of *class* n if the hyperpencil is a plane of lines. The cone is called *cone of the complex;* and the curve, *curve of the complex*. Every point of space is the vertex of such a cone, and every plane contains such a curve. As above seen, if $n=1$, the cone degenerates into a plane (pencil of lines) and the curve

degrades into a point (pencil of lines enveloping it). The 'Neue Geometrie' of Plücker is chiefly devoted to the *quadratic* complex, $n=2$, and many of its cardinal properties are there discovered. For the literature of the subject, including the general doctrine of complexes, the reader is referred to the works above cited and to the bibliography below. We give next a very brief account of certain closely

Allied Theories

the study of whose connections and general comparative anatomy is one of the most instructive and fascinating chapters in the development of modern geometry.

Plane Geometry of the Point in Four-space.—Space that is 4-dimensional in points is also 4-dimensional in *lineoids* (ordinary 3-dimensional spaces). It is 6-dimensional in lines and also in planes. Hence in 4-space the *point* and the *lineoid* are *dual* (reciprocal) elements, and so are the *plane* and the *line*. The lineoid contains ∞^4 lines; the point, ∞^4 planes. The lineoid contains ∞^3 points and as many planes; the point contains ∞^3 lineoids and as many lines. Hence in 4-space, the point, plane, and line geometries of the lineoid are respectively dual to the lineoid, line, and plane theories of the point. Between any two of these pairs of reciprocal geometries there is a fact-to-fact correspondence, and the algebras of any such pair are identical. The emphasis here falls upon the fact that the line geometry of the lineoid (*i.e.*, ordinary line geometry) is precisely the same analytically as the geometry of the 4-space point regarded as the assemblage of its (generating) planes. For an introductory detailed account of the elements of the latter theory, and of the mentioned parallelism, see 'The Plane Geometry of the Point in Point-space of Four Dimensions' ('American Jour. of Math.,' vol. 25).

Geometry of (Ordinary) Space in Pentaspherical Coordinates.—The square of the tangent-distance from a point to a sphere is named the *power of the point with respect to the sphere.* Denote by x_k $(k=1, \ldots, 5)$ the powers of a point with respect to five fixed mutually orthogonal spheres. The x_k satisfy the identity $\Sigma x_k^2=0$. To any set of values of their ratios there corresponds a definite point and conversely. The quantities λx_k are called *pentaspherical point coordinates.* Their discovery and introduction into geometry are mainly ascribable to Gaston Darboux (cf. his memoir 'Sur une class remarquable de courbes et de surfaces algébriques,' 1873), but in part also to Felix Klein and Sophus Lie (cf. 'Mathematische Annalen,' vol. 5). In these coordinates the equation of a sphere is linear, *viz.*, $\Sigma m_k x_k=0$ $(k=1, \ldots, 5)$; conversely, every such equation represents a sphere. The radius is $\rho=(\sqrt{\Sigma m_k^2}):\Sigma(m_k \div R_k)$, where the R_k are the radii of the fundamental spheres. Certain analytic correspondences between line geometry (in Klein coordinates) and point geometry in pentaspherical point coordinates are immediately obvious. For example: in the former $\Sigma x_j^2=0$ $(j=1, \ldots, 6)$ is the identity satisfied by the line coordinates x_j; in the latter, $\Sigma x_k^2=0$ $(k=1, \ldots, 5)$ is the identity connecting the pentaspherical point coordinates; in the former, $\Sigma m_j x_j=0$ represents a linear complex; in the latter, $\Sigma m_k x_k=0$ represents a sphere; in the former, $\Sigma m_j^2=0$ means that the complex is special; in the latter, $\Sigma m_k^2=0$ signifies that the sphere is a point; and so on and on.

Sphere Geometry of Space.—In this doctrine, due to Sophus Lie, the sphere is taken as primary element. To pick out a sphere from among all the spheres of space, it is necessary and sufficient to know four independent things about it, as the (three) coordinates of its center and the length of its radius. Hence the sphere, like the line, has four independent coordinates, it has four degrees of freedom, and sphere geometry, like line geometry, is 4-dimensional. We have seen that every equation $\Sigma m_k x_k=0$ in pentaspherical point coordinates x_k represents a sphere, and conversely; hence the five coefficients m_k may be taken as *homogeneous sphere coordinates*, their ratios being equivalent to four *independents.* The system may be rendered homologous to that of the six line coordinates by introducing a sixth sphere coordinate m_6 by the definition, $im_6 \equiv \sqrt{\Sigma m_k^2}$, where $i=\sqrt{-1}$ and $(k=1, \ldots, 5)$. The *six* homogeneous, sphere coordinates m_j $(j=1, \ldots, 6)$ satisfy the quadratic identity $\Sigma m_j^2=0$, identical in form with that connecting the Klein line coordinates. The condition that the *spheres* m and m' shall be *tangent* is $\Sigma m_j m_j'=0$, which is precisely like the condition, $\Sigma x_j x_j'=0$, that the *lines* x and x' shall *intersect*, a most interesting and fruitful principle of correspondence discovered by Lie in his brilliant memoir, 'Über Complexe, in besondere Linien- und Kugel-Complexe, mit Anwendung auf die Theorie partieller Differentialgleichungen' ('Mathematische Annalen,' vol. 5, 1871).

Circle Geometry of Space.—In this beautiful and growing theory, principally due to the French mathematicians E. Cosserat, C. Stéphanos, and G. Koenigs, the circle is employed as primary or generating element of space. In this element, space is 6-dimensional, like point 4-space in lines or planes. A circle is determined as the intersection of two spheres, as $\Sigma m_j x_j=0$, $\Sigma m_j' x_j=0$ $(j=1, \ldots, 5)$. It is equally determined by any two spheres of the pencil or range, $\Sigma(m_j+\lambda m_j')x_j=0$, of spheres containing it, and, in particular, by any two of the included five of which each is orthogonal to one of the fundamental spheres. The equations of those special spheres correspond to the five λ-values that render the coefficients $m_j+\lambda m_j'=0$ in succession. For the sake of symmetry, the *ten* coefficients $p_{ik}=(m_k'-m_k m_i'$ are taken as homogeneous coordinates of the circle. That the ten are equivalent to the necessary and sufficient number *six* of independents is seen in the facts that only their ratios are essential and that they satisfy five (equivalent to three independent) quadratic identities of the form $\omega_\alpha(p)=2(p_{\beta\gamma}p_{\delta\epsilon}+p_{\beta\delta}p_{\epsilon\gamma}+p_{\beta\epsilon}p_{\gamma\delta})=0$. The circle geometry of space is not parallel to the line geometry of ordinary space, but it is parallel, in a fact-to-fact fashion, to the line and the plane geometries of point 4-space.

Theory of Circles Orthogonal to Sphere.—Two spheres m_k and m_k' $(k=1, \ldots, 5)$ are *orthogonal* when and only when $\Sigma m_k m_k'=0$; hence there are ∞^3 spheres orthogonal to a given sphere. A *circle* is *orthogonal* to a *sphere* when and only when any two (and hence all) of its

generating spheres are orthogonal to the sphere. There are, accordingly, ∞^4 circles orthogonal to a given sphere. A one-to-one correlation subsists between such circles and the lines of space. If, in the assemblage of spheres orthogonal to a given sphere, four mutually orthogonal spheres be taken as fundamental or coordinate spheres, any equation $\Sigma m_k x_k = 0$ $(k = 1, \ldots, 4)$ will represent a sphere of the assemblage, and conversely. Hence a pair of such equations will define a circle orthogonal to the fixed sphere, and conversely. It is immediately plain that the coordinates of the circle regarded as element of the assemblage of circles orthogonal to a given sphere are analytically precisely the same as the line coordinates of space. Hence the geometry of such a circle assemblage is analytically identical with line geometry. The first chapters of such a circle geometry are found in the doctor's dissertation (at Columbia University, 1904), 'The Geometry of Circles Orthogonal to a Given Sphere,' by Mr. C. S. Forbes.

Bibliography.—The literature of line geometry and allied theories is extensive and is rapidly increasing. In addition to the foregoing citations, may be mentioned the following works, which together with further citations contained in them constitute a complete bibliography of the subject: Cayley, 'On the Six Coordinates of a Line' (Collected Papers, vol. 7); Klein, 'Einleitung in die höhere Geometrie' and various memoirs by him in vol. 5 and subsequent volumes of *Mathematische Annalen;* Koenigs, 'La géométrie réglée et ses applications' (*Annales de la Faculté des Sciences de Toulouse*, vols. 3 *et seq.*); Cosserat, 'Sur le cercle considéré comme élément générateur de l'espace' (see preceding reference); Loria, 'Il passato ed il presente delle principali teorie geometriche'; E. Pascal, 'Repertorio die mathematiche superiori'; Sturm, 'Die Gebilde ersten und zweiten Grades der Liniengeometrie,' a synthetic treatise; Pasch, 'Zur Theorie der linearen Complexe' (Crelle's Journal, vol. 75); Study, 'Geometrie der Dynamen'; Jessop, 'Treatise on the Line Complex'; 'Encyklopädie der Mathematischen Wissenschaften,' vol. 3.

CASSIUS J. KEYSER,
Adrain Professor of Mathematics, Columbia University.

Geometry, Modern Analytical. No preliminary statement of the significance of this title could be quite satisfactory to any, much less to all. An adequate sense of its meaning can be gained only by study of the subject itself; and in this case, as in that of most other doctrines, it is better for the reader to end, than for the writer to begin, by an attempt at definition. Logically and historically modern analytical geometry is the outgrowth of Cartesian geometry (q.v.). The former, while in a sense it includes the latter as a special case, avails itself of many principles, processes, and points of view unknown to the older doctrine. It is the aim of this article to give a brief account of some of the modern notions and methods, with particular reference to the geometry of the plane. For further information the reader may consult the articles: GEOMETRY, CARTESIAN; CURVES, HIGHER PLANE; LINE GEOMETRY AND ALLIED THEORIES; CURVES OF DOUBLE CURVATURE, THEORY OF; SURFACES, THEORY OF; HYPERSPACES. As to related matter of pure geometry, see the articles: GEOMETRY, ELEMENTARY PURE; GEOMETRY, PURE PROJECTIVE; and GEOMETRY, NON-EUCLIDEAN. In the following, acquaintance with the elements of ordinary (Cartesian) geometry will be presupposed.

One-dimensional Spaces: Range and Pencil; Elements at Infinity.—Any geometric entity in a given space may be taken as generating element of the space, which is then regarded as the assemblage of all the elements of the chosen kind. A space being assumed, its dimensionality depends upon the choice of generating element and is the number of independent parameters, or coordinates, necessary for the determination of the element. This is what is meant, to take the most familiar examples, by saying that any surface, say a plane, is two-dimensional, and that ordinary space is three-dimensional, in points. Any space being assumed, it is always possible to select as element an infinity of different kinds of entities for any one (kind) of which the space shall have a prescribed dimensionality k. Thus the plane is two-dimensional in lines (see below), its dimensionality is 3 in circles, 4 in parabolas, 5 in conics, ..., while the dimensionality of ordinary space is 3 in planes, 4 in lines or in spheres (see LINE GEOMETRY), 6 in circles, etc. A plane curve may in general be conceived either as a *locus*, assemblage of its *points*, or as an *envelope*, assemblage of its (tangent) *lines*. In either view the curve appears as a *one*-dimensional space, of points in the former view, of lines in the latter. Of such one-fold spaces, the simplest, and hence in a sense the most important, varieties are the *range* and the *pencil*, the former being the straight line regarded as the locus or assemblage of its points, and the latter being the point regarded as the envelope or assemblage of its lines (the lines through it). Commonly the line is called the *base* of its range, and the point is called the *vertex* of its pencil. In passing it may be pointed out that if a *pair* or *triplet*, ... of points (lines) be taken as element of the line (point), the line (point) appears as a space of 2, or 3, ... dimensions in such pairs, triplets, ...

Let V and b respectively be any pencil and range. The plane being supposed Euclidean in respect to parallels (see NON-EUCLIDEAN GEOMETRY), V contains a single line parallel

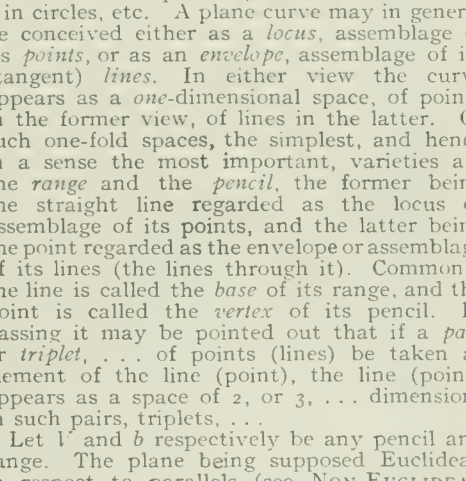


FIG. 1.

to b. Plainly, through any (finite) point of b there passes one and but one line of V: and, conversely, every line of V, except the mentioned parallel, passes through a (finite) point of b. In order to avoid the exception

and render the one-to-one correspondence complete, a convention is made, namely, that every range shall be regarded as having one and but one *infinitely distant* point P_∞, called the *infinite point* of the range, and that the infinite point of any range is identical with that of any parallel range. Accordingly any infinite point of the plane is the vertex of a pencil of parallel lines, and the system of lines parallel to a given one constitute a pencil vertexed at ∞. The notion of parallel lines meeting at ∞ had occurred to Kepler, but the systematic introduction of the convention was made by Gerard Desargues (1593–1662), chief among the founders of modern *pure* geometry. From that convention it readily follows, by the theory of similar triangles, that the (infinite) distances from any two finite points of a range to its infinite point are *equal*. The locus of the infinite points of the plane is a straight line, called *the infinite line* of the plane. As for space, the locus of its infinite points is a plane. In general the locus of the infinite points in a point-space of n dimensions is a point-space of $n-1$ dimensions. If a range rotate (in a plane) about one of its finite points, every other point of the range will generate a circle; the path of the infinite point being a straight line, the latter appears as a circle of infinite radius; a perfectly natural phenomenon, for the curvature, $1:r$, of a circle of radius r, vanishes for $r=\infty$.

Non-homogeneous and Homogeneous Coordinates of Point and Line of Range and Pencil.—In a range choose a point O for *origin* of distances. Denote by d the distance from O of an arbitrary point P of the range. Let $x=\rho d$, where the factor ρ may have any chosen value whatever. To any value of x there corresponds a position of P, and conversely. Hence x may serve as coordinate of the elements of the range. If a pencil be paired with a range as above, x will equally serve for coordinate of the lines of the pencil; or, in the latter case, d may be taken to represent the tangent of the angle made by a varying line of the pencil with a fixed line o, called *origin* of angles. Any point (line) of a range (pencil) will be represented by a linear equation $ax+b=0$, the coordinate of the element being $-b:a$. Conversely any element is defined by such an equation. In general n elements will give rise to an equation of nth degree in x, and any such equation will represent n elements. These (points or lines) will be real or *imaginary* elements of the range or pencil according to the corresponding character of the roots of the equation. All the equations can be rendered *homogeneous* by replacing x by the ratio $x_1:x_2$ and clearing of fractions. The quantities σx_1 and σx_2, σ being any chosen finite quantity called proportionality factor, are described as *homogeneous coordinates* of the point (line) of the range (pencil). The position of the element depends on the ratio of the quantities, which is the same as the ratio of the x's, and the element is accordingly spoken of as the point or line (x_1, x_2). One obvious advantage of the homogeneity thus introduced lies in the artistic quality, notably the symmetry, which it lends to the analysis; for example, the equation of a point assumes the form $a_1x_1+a_2x_2=0$; in particular, the equations of the origin and P_∞ are respectively $x_1=0$ and $x_2=0$. Obvious analogous interpretations hold for the pencil. Indeed it is at once evident that the geometry of the range and that of the pencil are *analytically one*. The algebra remaining the same, either geometry passes over into the other on a mere exchange of notions: point (line) for line (point), pencil (range) for range (pencil).

Geometric Interpretation of Homogeneous Coordinates.—In case of the range assume two origins O_1 and O_2 instead of one and let them be δ apart. These divide the range into two parts, the short segment *between* and the long one (including P_∞) *not* between O_1 and O_2. Strictly, any point of the range other than O_1 or O_2 is between these points, for the range is a *closed* figure, but the meaning of the preceding sentence is sufficiently clear. Let it be agreed that a point in the shorter segment is on the positive side of both O's, whence, naturally, a point in the longer segment will be on the positive side of the remoter, and on the negative side of the nearer, O. Denote by x_1 and x_2 respectively the distances of any point P from O_1 and O_2. For any P, $x_1+x_2=\delta$. To any pair of x's satisfying that relation there corresponds a point, and conversely. Hence the homogeneous coordinates σx_1, σx_2 of a point of a range are the distances (multiplied by any finite constant) of the point from two chosen fixed points. Analogously for the pencil, where, however, distances are replaced not by the angles but by the sines of the angles made by the variable line p with two fixed lines o_1 and o_2 and where it is understood that an angle and its vertical angle are one and the same angle.

Anharmonic Ratio.—The ruling notion in the doctrine of the range (pencil) is the *anharmonic* (double or cross) *ratio* of four elements. If x_1, x_2, x_3, x_4 be any four numbers (say any four values of a continuous variable x), the expression $(\overline{x_1-x_2}\cdot\overline{x_3-x_4}):(\overline{x_2-x_3}\cdot\overline{x_4-x_1})$ is called the anharmonic ratio of the four values taken in the order x_1, x_2, x_3, x_4, and is conveniently denoted by the symbol $(x_1x_2x_3x_4)$. If a one-to-one correspondence be established between the continuum of x-values and the elements of a geometric continuum, the notion of the anharmonic ratio of any four x-values may be and is associated with the corresponding four geometric elements, as the points of a range, the lines of a pencil, the planes of an *axal pencil* (assemblage of all planes containing a same line), and so on. The *order* of the elements is essential. The 24 possible permutations of 4 elements yield six (in general distinct) values of their anharmonic ratio. The exchange of two *alternate* elements, as x_2 and x_4, *inverts* the ratio. Thus, if $(x_1x_2x_3x_4)=r$, then $(x_1x_4x_3x_2)=1:r$. To exchange two *consecutive* elements, as x_2 and x_3, takes the *complement* of the ratio to 1. Thus $(x_1x_3x_2x_4)=1-r$. The six values are r, $1:r$, $1-r$, $1:(1-r)$, $(r-1):r$, $r:(r-1)$.

Geometric Interpretation of Anharmonic Ratio in Range and Pencil.—Let x_1, x_2, x_3, x_4 be the distances of the points P_1, P_2, P_3, P_4 of a range from the origin. Then x_1-x_2, x_3-x_4, x_2-x_3, x_4-x_1 represent, in sign and magnitude, the distances $\overline{P_1P_2}$, $\overline{P_3P_4}$, $\overline{P_2P_3}$, $\overline{P_4P_1}$. Hence

$(x_1x_2x_3x_4) = (P_1P_2P_3P_4) =$ the *ratio* of the *distance ratios* $\overline{P_1P_2}:\overline{P_2P_3}$ and $\overline{P_1P_4}:\overline{P_4P_3}$. In case of a pencil, if the x's denote the tangents of the angles α_1, α_2, α_3, α_4 made by the lines p_1, p_2, p_3, p_4 with the origin, or fixed line, o, then $x_1 - x_2$, . . . are the tangent differences $\tan\alpha_1 - \tan\alpha_2$, . . . , and $(x_1x_2x_3x_4) = (p_1p_2p_3p_4) = \{(\tan\alpha_1 - \tan\alpha_2)(\tan\alpha_3 - \tan\alpha_4)\} : \{(\tan\alpha_2 - \tan\alpha_3)(\tan\alpha_4 - \tan\alpha_1)\} = \{(\sin\overline{\alpha_1 - \alpha_2})(\sin\overline{\alpha_3 - \alpha_4})\} : \{(\sin\overline{\alpha_2 - \alpha_3})(\sin\overline{\alpha_4 - \alpha_5})\} =$ the *ratio* of the *sine ratios* $(\sin\overline{p_1p_2}):(\sin\overline{p_2p_3})$ and $(\sin\overline{p_1p_4}):(\sin\overline{p_4p_1})$, where p_ip_κ means the angle between p_i and p_κ reckoned from the former to the latter.

Special Relations of Four Elements.—These correspond to equalities among the six anharmonic ratios, and conversely. By equating r in succession to each of the other ratios, the following special values of the ratios are found: 1, -1, 0, ∞, 2, $\frac{1}{2}$, ω, and ω', the last two being the imaginary cube roots of -1. If $r = 1$, the six values are $1, 1, 0, 0, \infty, \infty$; if $r = -1$, the six are $-1, -1, 2, 2, \frac{1}{2}, \frac{1}{2}$; if $r = \omega$ or ω', they are $\omega, \omega, \omega, \omega', \omega', \omega'$; finally, if $r = 0$ or ∞, the six values are $0, \infty, 1, \infty, 1, 0$. The special relations accordingly fall into three cases, *viz.*, $r = 1$, $r = -1$, $r = \omega$. If $r = 1$, either $x_1 = x_3$ or $x_2 = x_4$, *i.e.*, two of the points (lines) coincide. Hence this case is called the *coincident* case. If $r = -1$, then, if s_1 and s_2 are the intervals into which the range (pencil) is divided by a pair of alternates, one element of the remaining pair is in s_1 and the other is in s_2; the pair x_1, x_3 is said to be *harmonically* related to the pair x_2 x_4; and conversely. In particular if one of the points bisects the finite segment s_1 the alternate point bisects the other segment s_2, *i.e.*, it is the infinite point of the range. And if one line bisects the angle s_1, the alternate line bisects the supplementary adjacent angle s_2. The case, $r = -1$, called the *harmonic* case, is of great importance, leading to the theory of *involution;* all point (line) pairs of a range (pencil) that are each harmonic (conjugate) to a fixed pair are said to constitute an involution of points (lines.) The case, $r = \omega$, is called *equianharmonic* (by Cremona) because the six values fall into two triplets, instead of three pairs, of equals. This case serves as a door for the entrance of imaginary elements into the geometry of the range (pencil), for obviously four *real* points (lines) cannot have an imaginary anharmonic ratio.

Conjoined Range and Pencil.—From any line a range is cut by any pencil, as in Fig. 1. If the elements be paired so that each line

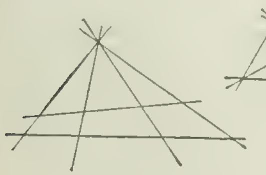


FIG. 2.

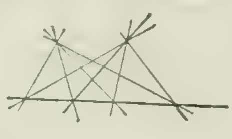


FIG. 3.

corresponds to the point it passes through, the range and pencil are said to be *in perspective* or to be *conjoined.* *Two ranges* (Fig. 2) conjoined with a same pencil are said to be *in perspective;* the vertex of the pencil is called the *centre* of perspective. Also *two pencils* (Fig. 3) conjoined with a same range are said to be *in perspective;* the base of the range is named *axis* of perspective. If a range and a pencil are conjoined and if P_1, P_2, P_3, P_4 be any four points of the range and p_1, p_2, p_3, p_4 are the corresponding lines of the pencil, then, by definition of anharmonic ratio, $(P_1P_2P_3P_4) = (p_1p_2p_3p_4)$, a theorem which in another form was known to Pappus (about 300 A.D.). It follows that corresponding anharmonic ratios of any two perspective ranges (pencils) are equal.

If the elements of two ranges or pencils or a range and a pencil be paired in such way that corresponding anharmonic ratios are equal, the two systems are said to be *projective.* Obviously, if the anharmonic ratio of four elements of which three are known be given, the fourth element is uniquely determined. It follows that any two projective systems can be placed in perspective. To place two projective ranges P_1, P_2, P_3, P_4, . . . , and P_1', P_2', P_3', P_4', . . . , in perspective, it suffices to place P_1 on P_1' and to take for perspective center the common point of the lines joining P_2 to P_2' and P_3 to P_3'. Similarly for two projective pencils.

The Anharmonic Ratio as Coordinate.—Let $(abcx) = r$ be the anharmonic ratio of four elements of which a, b, c are *fixed* and x is *variable.* To each value of x, *i.e.*, to each point (line) of the range (pencil), there corresponds one value of r, and conversely. Hence the anharmonic ratio r may be taken as coordinate of the point (line) of a range (pencil), referred to three arbitrarily taken fixed points (lines) of it. Now, $(\infty\ 1\ 0\ x) = x$; hence, if x in case of a range denote distance from the origin, it appears that the ordinary *distance-coordinate* of a point is its anharmonic ratio referred to the infinite point, the point 1 and the origin, of the range. Similarly, if for fixed lines be taken two perpendicular lines (of which one is the ordinary origin) and the bisector of their angle, the anharmonic ratio of those lines and a (variable) fourth line is the tangent (coordinate) of the angle of this line and the origin. The anharmonic ratio is thus seen to be the coordinate par excellence of the element of any one-fold continuum.

Linear Transformation.—The importance of the anharmonic ratio in the theory of simple continua comes clearly to view in connection with the linear transformation of them. The general equation of such transformation is $x' = (ax + b):(cx + d)$. To any point (line) x corresponds one point (line) x'. Viewing the transformation as an operation on all the elements at once, we say that each element x is transformed or converted into an element x'. Obviously the range (pencil) is converted into itself as a whole, the arrangement of the elements being in general changed. It is plain, too, that the transformation can be used to pair the elements of a range (pencil) with those of a pencil (range) or to pair two ranges or two pencils. The three independent ratios of the coefficients a, b, c, d are the parameters of the transformation. Hence there are ∞^3 transformations. Any two of them are equivalent to a third, and so they constitute a *group* (see GROUPS, THEORY OF); and the parameters

can be so determined as to convert any specified three elements into three specified elements. If x_1, x_2, x_3, x_4 be any four elements of a system (range or pencil) and if x_1', x_2', x_3', x_4' be the correspondents of the same or other system of the same or the other kind, then $(x_1x_2x_3x_4) = (x_1'x_2'x_3'x_4')$; *i.e.*, the anharmonic ratio is an absolute *invariant* (see INVARIANTS) under every transformation of the group. It is this property of invariance that lends the anharmonic ratio its great importance in geometry. Because anharmonic ratios are preserved by it, the linear transformation is called *projective:* any two systems paired by it are projectively related. Every transformation of a system into itself leaves two elements *fixed.* These are found by writing x for x' and then solving for x. The fixed elements, variously called the *poles, foci, double* or *conjugate* elements, of the transformation, will be real and distinct, coincident or imaginary, according as the *discriminant*, $D \equiv (d-a)^2+4bc$, is positive, zero, or negative; and the corresponding transformations are described respectively as *hyperbolic, parabolic,* and *elliptic,*—distinctions that cannot be here further pursued. In homogeneous coordinates the linear transformation is defined by the pair of equations $\rho x_1' = ax_1 + bx_2$, $\rho x_2' = cx_1 + dx_2$.

Range and Pencil; Dual Elements of the Plane.—Hitherto we have been mainly concerned with the line and the point (the range and the pencil) considered *in themselves.* These one-dimensional spaces are now to be viewed as *elements* of a twofold space, the plane. In Cartesian coordinates the equation of the line is $Ax+By+C=0$, or $ux+vy+1=0$. The equation, which represents the line as a *range* of points (x, y), contains *two* parameters u and v, which determine the range, or line. Hence the plane is two-dimensional in *ranges* (lines) as well as in *pencils* (points). Since one and but one line is determined by any pair of values of u and v, u and v may be employed as *coordinates* of the *line.* We may speak of the line (u, v) as of the point (x, y). If u and v vary and x and y do not, the equation *represents the point* (x, y) as a *pencil* of lines (u, v). We have here simple illustrations of three important *principles* of modern analytical geometry. As the equation of the line contains two independent parameters, we conclude that the plane is two-dimensional in lines. The dimensionality of any space in an element is always the number of independent parameters involved in the general analytic representation of the element. This principle of "enumerating constants" to determine questions of dimensionality is one of many principles introduced into analytical geometry by Julius Plücker (1801–1868). Another is that of *multiple interpretation* of equations. Thus we have seen that a same equation may be interpreted to represent now a point and now a line. Another great principle is that of *duality* or *reciprocity* introduced into *analytical* geometry by Plücker, though it was before employed in *pure* geometry by Poncelet (1788–1867) and his contemporary Gergonne, to the latter of whom geometric nomenclature is indebted for the word duality. Two elements e and e' of a given space are dual elements of it when its dimensionality is the same in both and when the analytic representations of e and e' are identical in form. Thus the point and the line (more properly, the pencil and the range) are reciprocal elements of the plane. The analogues for space are the point and the plane, the equation $ux+vy+wz+1=0$ representing either a plane (u, v, w) as a field of points or a point (x, y, z) as a *sheaf* (*bundle*) of planes. The mentioned reciprocity of the point and the line is immediately evident in such familiar pairs of propositions as: two points (lines) determine a line (point); three points (lines) determine three lines (points). In general, to any proposition about points (lines) corresponds an immediately derivable proposition about lines (points). So arise two parallel geometries of the plane, or, say, two reciprocal aspects of one geometry. The two algebras are one: dually interpretable. Using two variables, as ξ, η, to denote either point or line, any equation $f(\xi, \eta)=0$ will represent either a curve as an assemblage or *locus* of points or a curve as an assemblage or *envelope* of lines (tangents). The degree of the equation is called the *order* of the locus, *i.e.*, the number of points common to it and an arbitrary range, and it is called

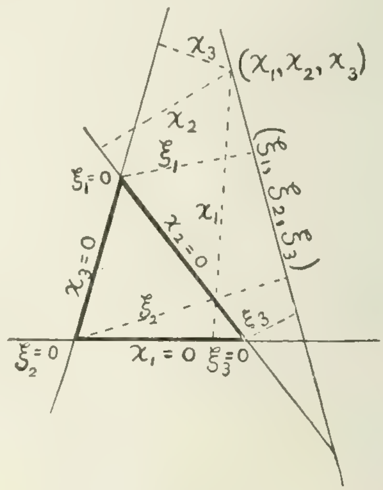


FIG. 4.

the *class* of the envelope, *i.e.*, the number of lines common to it and an arbitrary pencil. The two curves are in general not the same. But every curve, the point and line excepted, is conceivable as both a locus and an envelope and may at once be doubly generated as such: *i.e.*, by the figure of a point and a line through it so moving that the line is continuously tangent to the point's path at the point; such twofold genesis being another conception due to Plücker. Accordingly a curve has a point equation and a line (tangential) equation. For example, the ordinary point equation of the circle, centre at origin and radius r, is $x^2+y^2=r^2$; the line equation is $r^2(u^2+v^2)=1$. These are of the same degree, exemplifying the fact that every curve of *second* order is of *second* class, and conversely. In general, however, the order and the class of a curve are not equal; for example, the curve whose point equation is $x^3+y^3+1=0$ has for line equation the sextic, $u^6+v^6-2(u^3+u^3v^3+v^3)+1=0$, and is accordingly of order 3 and class 6.

Homogeneous Point and Line Coordinates and their Geometric Interpretation.—By replacing x by $x_1:x_3$, y by $x_2:x_3$, u by $\xi_1:\xi_3$, and v by $\xi_2:\xi_3$, all equations of loci and envelopes may be rendered homogeneous. In particular the equation of the line (point) becomes $\xi_1 x_1 + \xi_2 x_2 + \xi_3 x = 0$. The three ξ's (x's), or arbitrary multiples $\mu_i \xi_i$ ($m_i x_i$) of them, on whose two independent ratios the line (point) depends, are called the *homogeneous coordinates of the line* (*point*). Such coordinates admit of various closely allied interpretations of which the simplest is that, Fig. 4, in which the x's (ξ's) are the distances of the point (line) from the sides (vertices) of an assumed *fundamental* triangle, or triangle of *reference*, signs being so determined by convention that a point within the triangle is on the positive side of the three sides and that any two of the ξ's agree or do not agree in sign according as the corresponding line does not separate or separates the corresponding vertices. Such coordinates are often called *triangular* or *trilinear*. Plainly, they may be replaced by arbitrarily chosen multiples of them The x's (ξ's) are, of course, not independent. If Δ denote the area of the triangle and a_1, a_2, a_3 the lengths of its sides, the distances x satisfy the identity $a_1 x_1 + a_2 x_2 + a_3 x_3 = 2\Delta$. An analogous identity connects the ξ's. The x's and the ξ's need not be referred to the same triangle, but when they are (and that is generally the most convenient convention), the foregoing equation of the line (point) signifies also that the line and point it represents are united in position. Homogeneous coordinates were first employed, from mechanical motives, by Möbius in his 'Barycentrischen Calcul,' 1827, and by Plücker, from geometric motives, in his 'Analytisch-geometrischen Entwickelungen,' 1828. The artistic and economical device of denoting several coordinates by a single letter distinguished by subscripts was introduced by Hesse (1811–1874), whose 'Analytische Geometrie des Raumes,' 1861, remains a model of elegance.

The Method of Abridged Notation, and the Conics.—This powerful method, simultaneously and independently introduced into geometry by Plücker (cf. 'Entwickelungen,' above) and by Bobillier (*Annales de Gergonne*, vol. 18, 1827–8), consists primarily in denoting by a single letter the left-hand member of the equation of a curve or surface, whence the curve or surface is represented by placing the letter equal to zero. The advantages of the method, as combining ideally with the method of parameters and as greatly economizing at once both physical and intellectual energy, are obvious. For an illustration, let $P^i \equiv x_1{}^i\xi_1 + x_2{}^i\xi_2 + x_3{}^i\xi_3$ and $L^i \equiv \xi_1{}^i x_1 + \xi_2{}^i x_2 + \xi_3{}^i x_3$, then the equations $P^i = 0$, $L^i = 0$ will respectively represent a point and a line. If $P' = 0$ and $P'' = 0$ be two points, their range is represented by $P' + \lambda P'' = 0$, definite points of the range corresponding to definite values of the parameter λ; in like manner the pencil determined by two lines $L' = 0$ and $L'' = 0$ is $L' + \lambda L'' = 0$. In general the points (lines) common to any two loci (envelopes) $C' = 0$ and $C'' = 0$ are common to all the loci (envelopes) of the family $C' + \lambda C'' = 0$. If $\lambda' = (a\lambda + b).(c\lambda + d)$, the two pencils, $L' + \lambda L'' = 0$, $L''' + \lambda' L^{iv} = 0$, are projectively related. Any pair of corresponding lines determine a point. By elimination of λ and λ', the equation of the locus, Fig. 5, of all such points is found to be $aL'L^{iv} - bL''L^{iv} - cL'L''' + dL''L''' = 0$.

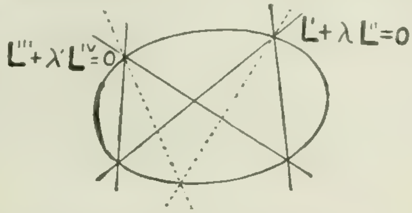


FIG. 5.

This being of second degree in point coordinates, the locus is of second order, a conic containing the vertices of the given pencils. Reciprocally, the envelope, Fig. 6,

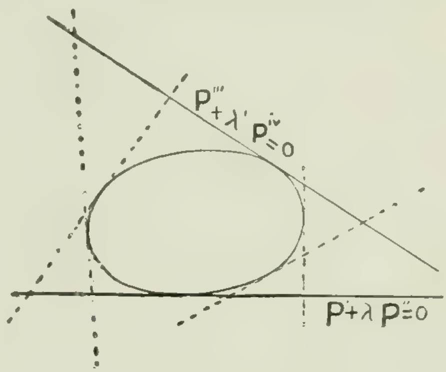


FIG. 6.

$aP'P^{iv} - bP''P^{iv} - cP'P''' + dP''P''' = 0$, of the lines joining corresponding points of two projective ranges, $P' + \lambda P'' = 0$, $P''' + \lambda' P^{iv} = 0$, is of second class, a conic touching the (bases of) the given ranges. The number and species of the conic depend on the ratios of the constants a, b, c, d. Obviously there are ∞^3 loci of second order (envelopes of second class) passing through two given points (touching two given lines).

Near-lying subjects such as the general conic, systems of conics, poles and polars, transformations, the circular points at infinity, circle and other geometries of the plane, cannot here be broached, much less the corresponding subjects in space.

Bibliography.—In addition to the works above cited, the following may be named as those which render the subject most readily accessible: Charlotte A. Scott, 'An Introductory Account of Certain Modern Ideas and Methods in Plane Analytical Geometry'; Fiedler's German edition of Salmon's 'Conic Sections' and 'Geometry of Three Dimensions'; Lindemann's 'Vorlesungen über Geometrie von Clebsch' (also in French, by Benoist).

CASSIUS J. KEYSER,
Adrain Professor of Mathematics,
Columbia University.

Geometry, Non-Euclidean. The primitive meaning of Non-Euclidean Geometry was the system which follows from the denial of Euclid's Postulate: «Through a given point there is not more than one parallel to a given straight

line,» when all of Euclid's other assumptions, explicit and unconscious, are retained.

It has sometimes been used in the sense of what Bolyai called Absolute Geometry and Lobachévski Pangeometry, namely, the system which simply dispensed with the above Euclidean Postulate, using neither it nor any contrary assumption; undifferentiated, therefore, as between Euclidean and primitive non-Euclidean.

When Euclid's tacit assumption, «the straight line is infinite,» is also dispensed with, we have Metageometry.

When this tacit assumption is denied, we have two new systems, to which the name non-Euclidean was immediately extended.

At present, by a non-Euclidean geometry is meant any system of geometry which, while differing in essential particulars from that of Euclid, is nevertheless in accord with experience and experiment, within the limits of the errors of observation. The space in which such a geometry is true is a non-Euclidean space.

The easiest way to get an appreciation of non-Euclidean geometry is to begin by following its early development historically.

The promise of its birth goes back almost to Euclid's very day, for it arose from endeavors to improve his treatment of the theory of parallels, which was the one point where his wonderful Elements had been criticised from antiquity. The attempts of Proklos and Claudius Ptolemæus to improve on Euclid here have been preserved to us. They were the first of a long line of geometers of every rank who have toiled over what they thought a blemish.

Such attempts may be classified under the three following heads:

1. *The Substitution of a Different Definition of Parallels.*—Euclid's own definition was: Two parallels are coplanar straights with no common point. It remains to this very day the only good definition of parallels for elementary geometry. The introduction of infinity in modern geometry gives its characteristic definition due to Desargues, 1639: Parallels are straights on a common point at infinity (figurative point). This has the advantage (1) of being freed from the necessity of specifying coplanarity, and (2) hence of giving an exact analogue for planes: Parallel planes are planes on a figurative straight; (3) of being wholly positive instead of chiefly negative; (4) of giving the dual in the plane of the fundamental «2 points determine a straight,» namely, «2 straights determine a point,» and hence the inestimable advantages of duality for the plane, including the doctrine of poles and polars.

But so far was the explicit use of infinity from being considered allowable in elementary geometry, that Borelli in 1658 objected to even so much of infinity as is implicit in Euclid's phrasing of «with no common point,» namely, «and which being produced ever so far both ways do not meet,» and so proposed as substitute: Parallels are straights with a common perpendicular

Géminos (about 100 B.C.) had defined parallels as straights everywhere equidistant, but Giordano da Bitonto (1680) saw that this presupposed the assumption of Clavius, 1574, that a line coplanar with a straight and everywhere equidistant from it is itself straight; so using a figure found in Clavius, made by joining together the ends of two equal perpendiculars to a straight, he tried to prove this join everywhere equidistant from the straight. This very figure reappears in Saccheri, of whom more anon.

Another definition is, Parallels are straights having the same direction. This also is worse than worthless.

2. *The Substitution of a Different Postulate.*—Of these the most famous is due to W. Ludlam, fellow of Saint John's College, Cambridge, who, in his 'The Rudiments of Mathematics' (1794), says: « The 12th axiom is not properly an axiom; but, instead of it, you may substitute the following simple proposition. Axiom: Two straight lines meeting in a point, are not *both* parallel to a third line.» This axiom has been persistently attributed to Playfair, despite the fact that he explicitly credits it to Ludlam in a note in his Euclid, on Prop. XXIX, where he says: «This axiom has been assumed by others, particularly by Ludlam, in his very useful little tract entitled 'Rudiments of Mathematics.' »

Other famous alternative postulates are those of Wallis, 1663: «To any triangle another triangle as large as you please can be drawn which is similar to the given triangle»; of Saccheri: «There is a triangle whose angle-sum is two right angles»; of Bolyai, F.: «Every three points are costraight or concyclic.»

3. *The Attempt to Deduce Euclid's Postulate from his Other Assumptions.*—The most famous is by Saccheri in his book 'Euclid Vindicated from Every Fleck' (Milan, 1733).

Ostensibly this is simply a very long demonstration of Euclid's Postulate by the indirect method, *reductio ad absurdum*. Denying this postulate and assuming a contradictory postulate together with all Euclid's other assumptions, if contradiction follows, this contradictory postulate is disproved. If thus the only possible alternatives to Euclid's Postulate are disposed of, it is demonstrated.

On the surface, then, it seems that Saccheri supposed himself to have proved the indemonstrable postulate.

If so, he has no claim to be the discoverer of non-Euclidean geometry. But upon a profounder study of his marvelous work, the suspicion comes that he knew the logical and mathematical truth of one at least of his non-Euclidean hypotheses and the consequent final and eternal indemonstrability of Euclid's Postulate. In that case, he cherished his work, just as we do, not for its fallacious conclusion, necessitated to get for his book the *imprimatur* of the Inquisition and of the Society of Jesus, Saccheri being a Jesuit, but for the beautiful non-Euclidean results which immortalize it.

The angles at the extremities of two equal perpendiculars are equal and either right, obtuse, or acute. These are Saccheri's three hypotheses: the hypothesis of right angle, the hypothesis of obtuse angle, the hypothesis of acute angle.

The first is Euclid. The last is the primitive non-Euclidean geometry.

This was consciously discovered by Schweikart in 1812 at Charkow, communicated to Bessel, and in 1818 a written statement of it sent to Gerling which he was afterwards asked to transmit to Gauss. He did so, and thus

this precious document, the first published (not printed) non-Euclidean geometry, is still preserved. (Translated by Halsted, 'Science,' N. S., Vol. XII, pp. 842–846.) Two of its theorems are: (*a*) The sum of the three angles in the triangle is *less* than two right angles; (*b*) This sum becomes smaller the more content the triangle encloses.

The first to print a non-Euclidean geometry (1829–30) was a Russian-Lobachévski, professor of mathematics in the new University of Kazan.

In place of Euclid's Postulate he substitutes the following, which directly contradicts it: «All straight lines which, in a plane, radiate from a point, can, with reference to any given straight line in the same plane, be divided into two clasess—into *cutting* and *not cutting*. The *boundary lines* of the one and the other class are called *parallel to the given line.*»

If the length of the perpendicular from the given point to the given straight line be p, the acute angle it makes with either of the two parallels is denoted by $\Pi(p)$. With a suitable choice of the unit of length, $\tan \frac{1}{2}\Pi(p) = e^{-p}$.

Lobachévski never claimed to have discovered the non-Euclidean geometry before 1826, and the tell-tale title of his paper of 1826, 'Exposition succincte des principes de la Géométrie avec une demonstration rigoreuse du théorème des parallèls,' has never been explained.

Even in 1837 in Crelle's Journal he made the mistake of calling his discovery «Géométrie Imaginaire.»

How different the brilliant young Hungarian, John Bolyai, who in 1823 had written to his father Bolyai Farkas (Wolfgang Bolyai): «I have discovered such magnificent things that I am myself astonished at them. It would be damage eternal if they were lost. *From nothing I have created another wholly new world.*»

His brief exposition of this new world, with the same unflinching recognition of its momentous importance, he calls «The Science Absolute of Space.» It is the most extraordinary two dozen pages in the history of human thought. It was published in 1831 as an appendix to the first volume of a work by his father.

In this tiny appendix, with unparalleled boldness and power, the young Magyar hero squares the circle in Bolyai space, shows that the area of the greatest possible triangle (which has all its sides parallel and all its angles zero) is πi^2, where i is what is now called the space constant, shows how through a given point to draw a parallel to a given straight, and how to draw a perpendicular to one arm of any acute angle which shall be parallel to its other arm.

To get a sharp idea of this primitive non-Euclidean geometry, which may be named after either Lobachévski or Bolyai, contrast a few of its theorems with some of Euclid's:

Proposition 32, Book I of Euclid, is that the sum of the angles in every rectilineal triangle is *just exactly* two right angles. In Bolyai geometry, on the contrary, the sum of the angles in every rectilineal triangle is *less* than two right angles.

In the Euclidean geometry parallels *never* approach. In this non-Euclidean geometry parallels *continually* approach.

In the Euclidean geometry all points equidistant from a straight line are on a *straight* line. In this non-Euclidean geometry all points equidistant from a straight line are on a *curve* called the equidistantial.

In the Euclidean geometry the limit approached by a circumference as the radius increases is a *straight* line. In this non-Euclidean geometry this limit is a *curve* called the oricycle. Thus the method of Kempe's book, 'How to Draw a Straight Line,' would here draw not a straight line, but a curve.

In the Euclidean geometry, if three angles of a quadrilateral are right, then the fourth is *right*, and we have a rectangle. In this non-Euclidean geometry, if three angles of a quadrilateral are right, then the fourth is *acute*, and we never can have any rectangle.

In the Euclidean geometry two perpendiculars to a straight line remain *equidistant*. In this non-Euclidean geometry two perpendiculars to a straight line *spread away from each other* as they go out; their points two inches from the straight line are farther apart than their points one inch from the line.

In the Euclidean geometry every three points are either on one straight line or on one circle. In this non-Euclidean geometry there are triplets of points which are *neither costraight nor* concyclic. Thus three points each one inch above a straight line are neither on a straight line nor on a circle.

In 1867, after Riemann's death, was published an inaugural lecture he had delivered in 1854: 'On the Hypotheses which are at the Foundation of Geometry.' Here occurs for the first time the extraordinary advance that the straight line may be closed and finite; that space though unbounded may still be finite, that, for example, a finite number of our common building bricks might be written down which might be more than our universe could contain. This at once gave Saccheri's «hypothesis of obtuse angle» equal standing with his other two, giving a new genus of non-Euclidean geometry, the Riemannian, with two species, the elliptic and the spheric. These varieties of Riemann's space are also called the polar and antipodal forms of elliptic space, Euclid's space being called parabolic, and that of Bolyai and Lobachévski hyperbolic, space. Riemann gets his profound hold of this matter with the aid of two fundamental conceptions, that of a *manifold*, and that of what he called the *measure of curvature* of a continuous manifold having flatness in its smallest parts. This phraseology, especially the use of the word curvature, proved unfortunate, misleading philosophers and even mathematicians into supposing non-Euclidean spaces curved and necessarily contained in Euclidean spaces. How far this is from being the case is shown by the beautiful «Theorem of Barbarin»: «Each of the three spaces, Euclidean, Lobachévskian, Riemannian, contains surfaces of constant curvature of which the geodesic lines have the metric properties of the straight lines of the three spaces.» Riemann himself created point-manifolds with measure of curvature not zero utterly without reference to anything not contained in the manifold itself. Hence to avoid all appearance of implying for non-Euclidean spaces a curva-

ture in Euclidean space, the phrase *space-constant* serves, it being equal to the reciprocal of the square root of Riemann's measure of curvature.

Lambert in his 'Theorie der Parallellinien' (1766), showed that Saccheri's «hypothesis of obtuse angle» holds on a sphere, and to-day pure two-dimensional spherics is not only the best Euclidean analogue of a Riemannian geometry, but inversely the geometry of two-dimensional antipodal Riemannian space gives the best insight into Euclidean spherics and spherical trigonometry. These reciprocal advantages will be found utilized in Chapter XV, *Pure Spherics*, of Halsted's 'Rational Geometry,' which may be taken as the simplest, most detailed, most complete Riemannian geometry in print.

But it must not be supposed that the surface of a sphere *is* a plane of antipodal Riemannian space. They have the same internal relations, abstraction made of all points not *on*, that is, *in* them. To realize how tremendously different they are in other respects, you have only to recall that the sphere has a triple infinity of points within it, including the center, while the antipodal Riemannian plane has no points within it, no points toward which it is concave.

In the polar form of Riemannian space two coplanar straight lines always intersect once and only once. A complete straight line does not divide a plane; a plane does not divide space, it is unilateral. In this space alone do we have complete, absolute point and plane duality.

Another genus of Euclidean analogues of non-Euclidean spaces was obtained by Klein by a variation of the absolute in Cayley's projective metrics. The coordinates employed in the projective foundation of metrics must be defined non-metrically. This is accomplished by means of the pure projective geometry of von Staudt founded on his famous quadrilateral construction, by which, entirely without any metrical presuppositions, order is assigned among the points of a line. This Cayley-Klein translation of non-Euclidean systems furnished a final proof that no logical outcome of a non-Euclidean geometry could ever be self-contradictory, since any self-contradiction in a non-Euclidean system would be but a like self-contradiction in the Euclidean system. Another equally sweeping but much simpler proof of this on the same principle is given by Poincaré in his remarkable book, 'Science and Hypothesis.'

To the genius of Helmholtz is due the conception of studying the essential characteristics of a space by a consideration of the movements possible therein. Felix Klein it was who first called the attention of Lie to this work of Helmholtz, and pointed out its connection with Lie's group-theory. In 1886 Lie gave briefly his weightiest results. The whole investigation, published in Vol. III of his 'Theorie der Transformationsgruppen,' 1893, was in 1897 awarded the first Lobachévski Prize, a great recurring prize founded at Kazan by contributions from all over the world in honor of the Russian creator of the first non-Euclidean geometry. If Hungary had a man like Vasiliev of Kazan, she too would be honoring herself by marking with a Bolyai Prize her pride in the greatest idea which ever originated in a Magyar brain.

Lie proves that free motion in the strict meaning of the word can happen in three and only three spaces, namely, the traditional or Euclidean space and the two kinds of non-Euclidean space, a Bolyai space, a Riemann space, of which latter there are two species. These four are thus the only spaces allowing free motion as a whole.

A new genus of non-Euclidean spaces, forms of space which do not allow free motion as a whole, called by Killing the Clifford-Klein spaces, may be said to have arisen from Clifford's unbounded surface of finite extent and zero curvature, whose connectivity and geometry are those of a plane Euclidean parallelogram whose opposite sides correspond point for point, these opposite pairs being considered as one point. The connectivity is that of an anchor-ring.

In this the moving on itself of the closed surface in its totality is sharply restricted, while the movements of a comparatively small area on the closed surface remain unrestricted. Clifford's surface is the locus in the polar form of Riemannian space of the point whose perpendicular to a given straight is congruent to a given sect, that is, of points at a constant distance from a given axis. This locus is a ruled quadric surface. The joins of the correlated points of two projective ranges whose bearers are not coplanar form a «ruled system» or regulus of straights no two coplanar. For were two coplanar, then two points on the bearer m and two on the bearer m_1 would all four be on this plane, and so m and m_1 coplanar, contrary to hypothesis.

Let the straights n, n_1, n_2 be any three of the elements of a ruled system, and N_2 any point on n_2. Put a plane on N_2 and the straight n_1, and let its pass with n be called N. The straight NN_2 cuts n, n_1, n_2 all three. Projecting the generating ranges of the ruled system (on the bearers m and m_1) from the straight NN_2 (or m_2) as axis produces two projective axial pencils, which having three planes m_2n, m_2n_1, m_2n_2 self-corresponding are identical. Therefore every pair of correlated points of the ranges on m and m_1 is coplanar with m_2; that is, m_2 cuts every element of the ruled system.

By varying the point N_2 we obtain ∞^1 straights, all cutting all the ∞^1 straights of the original ruled system and making on every two projective ranges. Of the straights so obtained no two cross, for that would make two of the first ruled system coplanar. Either of these two systems may be considered as generating a «ruled surface,» which is the bearer of both.

Each of the two systems is completely determined by any three straights of the other, and therefore so is the ruled surface also. From the construction follows that the straights of either ruled system cut all the straights of the other in projective ranges. So any two straights of either system may be considered as bearers of projective ranges generating the other system, or indeed the ruled surface. On each point of this ruled surface are two and only two straights lying wholly in the surface (one in each ruled system). The figure of two so united ruled systems, due to Monge, is one of the most noteworthy creations of modern geometry.

In Clifford's surface any two of the elements of the same ruled system have an infinity of common perpendiculars all congruent, as have also any element and the axis of the surface Clifford called all the elements of the same ruled system '*parallel*' to each other and to the axis.

Generalizing, a transformation in this polar space of three dimensions in which all straights of a certain straight-congruence remain fixed while any point is displaced along the straight of the congruence on which it lies is called a *translation*, and the straights of the congruence are called *Clifford Parallels*. From any point of either of two Clifford parallels a common perpendicular can be drawn to the two, and all such are congruent. Moreover, if a straight cut two Clifford parallels, the corresponding angles are congruent.

The Clifford parallels are of two kinds, according as the generators of the fundamental quadric which determine them are elements of one or the other of the two ruled systems of the quadric. Similarly translations are to be distinguished as of two kinds. Two successive translations of the same kind are equivalent to a translation, but two translations of different kinds are not equivalent to a translation.

From these considerations we get, even when the measure of curvature is taken as zero, by the side of ordinary Euclidean space three other types or species of the genus Clifford-Klein space, given by the use of translations alone. These may be studied from the Euclidean geometry: 1° Within a parallelopiped with three finite edges; 2° Within a parallelopiped one of whose edges becomes infinite; 3° Within a parallelopiped two of whose edges become infinite.

In the Clifford-Klein space corresponding to 1°, geodesics may have the finite length $la+mb+nc$, where a, b, c are the lengths of the edges of the parallelopiped and l, m, n are any three relatively prime integers. Geodesic surfaces may be like a plane, a cylindric, or an anchor-ring surface.

If, finally, the same considerations be applied to the case where the measure of curvature is a negative constant, there results an infinity of varieties corresponding exactly to the configurations considered by Poincaré and Klein in the theory of automorphic functions. The great importance of the Clifford-Klein space-forms rests upon this, that they show with especial clearness what a mighty difference it makes whether we, from the beginning, assume the geometric axioms as valid for space as a whole or merely for an every way bounded piece of space. In the first case we obtain, besides the Euclidean, only the three now well-known non-Euclidean space-forms. In the second case appears also a manifold, at present not yet dominated, of different space-forms, new non-Euclidean universes.

Bibliography.—A bibliography of non-Euclidean literature down to the year 1878 was given by Halsted, 'American Journal of Mathematics,' Vols. I, II, containing 81 authors and 174 titles, and reprinted in the collected works of Lobachévski (Kazan, 1886) giving 124 authors and 272 titles, which was incorporated in Bonola's 'Bibliography of the Foundations of Geometry' (1899), reprinted (1902) at Kolozsvár in the Bolyai Memorial Volume. Bonola adds the titles of 27 articles written by Halsted, a study and synthesis of which will be found in 'Euclid's Parallel Postulate' (Chicago, 1905, pp. i–x, 1–192). See also 'Report on Non-Euclidean Geometry' (American Association, 1899, and Supplementary Report on Non-Euclidean Geometry, 1901).

Saccheri, rediscovered, was first given to the world by a translation in the 'American Mathematical Monthly' (Vols. I and II). Lobachévski and Bolyai we have in the 'Neomonic Series,' published at The Neomon, Gambier, Ohio: (Vol. I); Vasiliev's 'Address on Lobachévski': (Vol. III); Bolyai's 'Science Absolute of Space': (Vol. IV); Lobachévski's 'Geometrical Researches on the Theory of Parallels': (Vol. V); 'Introduction to Lobachévski's New Elements of Geometry.' In French, 'La Géométrie non euclidienne;' par P. Barbarin, is a little gem. In German, for exposition, 'Nichteuklidische Geometrie,' von H. Liebmann (1905); for the sources, Stäckel and Engel, 'Die Theorie der Parallellinien' (1895); Engel, 'Lobatschefskij' (1899).

GEORGE BRUCE HALSTED,
Professor of Mathematics, Kenyon College, Gambier, Ohio.

Geometry, Pure Projective. *Introductory.*—Projective geometry, as the name indicates, has to do with the theory of projection. Pure projective geometry is that which is conducted by means purely geometric, without initial recourse to algebraic methods (see GEOMETRY, MODERN ANALYTICAL), and which makes only subordinate mention of properties other than projective. The adjective synthetic is frequently used as practically a synonym for pure.

The process of projection is of constant occurrence—*e.g.*, in photographing (the lens must be strictly rectilinear), in preparing a lantern-slide from the photographic plate, and in throwing the image upon a screen. Thus in passing from an object to its representation upon the screen there are three successive projections—a fourth enters with the visual image formed upon the retina when the screen is viewed. Fig. 1 serves to illustrate the process of projecting a line $ABCD$ into another $A''B''C''D''$.

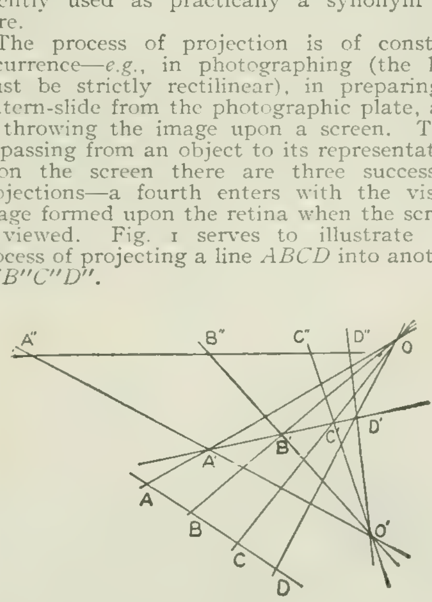


FIG. 1.

Reference to the figure will show that the length of a line is changed by projection AB is not equal to $A''B''$. Moreover, even the ratio of two lengths is changed. $AB \div BC$ is

not equal to $A''B'' \div B''C''$. The study of projective geometry is the study of such properties of figures as are unaltered by successive projections. Lengths and ratios of lengths are not such properties, and by right enter only subordinately into pure projective geometry.

Historically considered, projective geometry arose by considering changes in lengths, and was thus far from pure. A theorem attributed to PAPPUS (q.v.) states that the *double ratio* of the lengths is unchanged by projection—thus,

$$\frac{AB}{BC} \div \frac{AD}{DC} = \frac{A'B'}{B'C'} \div \frac{A'D'}{D'C'} = \frac{A''B''}{B''C''} \div \frac{A''D''}{D''C''}.$$

It was upon such basis as this that the subject developed until VON STAUDT (q.v.) in his famous 'Geometrie der Lage,' published in 1847, showed how the development might proceed in a manner more truly in the spirit of pure projective geometry. From the publication of this book dates the modern point of view in treating projective geometry as a pure self-sustaining branch of mathematics. It is this point of view that is here adopted.

Fundamental Notions.—Properly to appreciate pure projective geometry it is necessary definitely to take a point of view radically distinct from that taken in ordinary elementary geometry. This may perhaps be done best by making a first appeal, as von Staudt did, to the physical sensation of sight. What characterizes ordinary geometry (which is usually called *metrical*, as opposed to projective geometry) is its close relation to the conceptions of rigid motion, of distance, and of measurement—in short, to things connected with the sensation of touch. Whereas projective geometry is intimately concerned with the look (Schein) or projection of objects and not with their actual dimensions. Thus in the figure the set of points A, B, C, D would have the same 'look' to an observer at O as would A', B', C', D'; and these in turn would appear the same from the point O' as would A'', B'', C'', D''. There is, however, one respect in which the idea of 'looking' must be generalized. If the view-point is situated between the points A', B', C' and A'', B'', C'', as in Fig. 2,

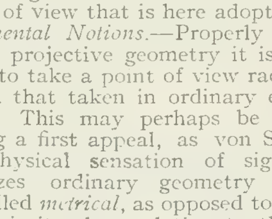


FIG. 2.

the sets of points are still said to 'look' the same, or to be projections of one another with respect to the point O'. Precisely herein lies the distinction between projective geometry and what has been called descriptive geometry (B. Russell, 'Principles of Mathematics,' p. 393). Namely, the former considers the line of vision or projection to be the whole line through the point of observation, whereas the latter takes it as merely a half-line and thus corresponds somewhat more closely to the real visual space.

The point, the straight line, and the plane are assumed as the fundamental geometric elements. They are denoted respectively by italic capitals A, B, C, . . . ; by lower case italics, a, b, c, . . . ; and by Greek letters, α, β, γ, . . . It may be noted that these elements are themselves projective, that is, appear respectively as points, line, and plane from any view-point not situated upon them. A circle has not this property: for when viewed from any point, not upon the line through its center and perpendicular to its plane, it appears noncircular. Hence the circle could not serve as a fundamental locus in pure projective geometry.

Fundamental Propositions. Parallelism.—There are a considerable number of immediately obvious relations connecting the fundamental elements, points, lines, planes. From among these it is necessary to select a certain number to serve as fundamental propositions or premises for future deductions. (Note. The propositions so selected may be called axioms or postulates. This, however, is not the place to discuss such matters, which belong to the foundations of mathematics. See LOGIC, SYMBOLIC.)

F. P. 1. Two points determine a line—the line joining them and upon which they lie.

F. P. 2. Two planes determine a line—their line of intersection and through which they pass.

F. P. 3. Three points not in the same line determine a plane—the plane passed through them and in which they lie.

F. P. 4. Three planes not passing through the same line determine a point—their point of intersection.

F. P. 5. A point and a line not passing through the point determine a plane.

F. P. 6. A plane and a line not lying in the plane determine a point—their point of intersection.

From these propositions follow a number of theorems:

Th. 1. If two points lie in a plane, the line joining them lies wholly in the plane. Proved from F. P. 3 and F. P. 5.

Th. 2. If two planes pass through a point, their line of intersection passes through the point. Proved from F. P. 4 and F. P. 6.

Th 3. If two lines have a point in common, they determine a plane. Proved by F. P. 3 and Th. 1.

Th. 4. If two lines lie in the same plane, they intersect in a point. Proved by F. P. 4 and Th. 2.

Th. 5. If two triangles are so situated that the lines joining corresponding vertices meet in a point, the points of intersection of corresponding sides lie on a line.

The proof in case the triangles do not lie in the same plane is as follows: Let ABC and $A'B'C'$ be the triangles. As AA' and BB' meet in a point, the lines AB and $A'B'$ determine a plane (Th. 3, Th. 1) in which they intersect (Th. 4). But as AB lies in the plane ABC, and $A'B'$ in the plane $A'B'C'$, they can only intersect on the line common to these two planes. Hence the intersection of AB and $A'B'$ is on this line. Similarly BC and $B'C'$, and CA and $C'A'$, intersect on this line. The proof in case the triangles lie in the same plane is obtained by comparing each of them with a triangle out of their plane.

Th. 6. Converse of Th. 5. Proof similar.

Th. 7. If two triedral angles are so situated that the lines of intersection of corresponding faces lie in a plane, the planes determined by corresponding edges pass through a line. The proof follows that of Th. 5.

Th. 8. Converse of Th. 7. Proof similar.

From the point of view of elementary geometry theorem 4 is incorrect and should read 'if two lines lie in the same plane they either intersect or are parallel.' What has become of parallelism? Reflexion will disclose that for projective geometry there is no such thing as parallelism. For, consider two parallel lines upon a horizontal plane and project them upon a vertical plane (as is done in photographing a straight, flat railroad track). In the projection the lines meet upon the horizon (Fig. 3). Thus the property

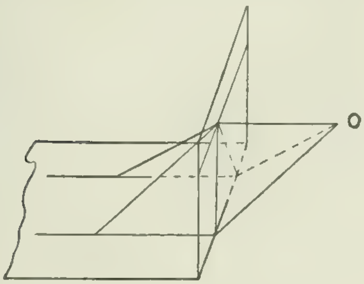


Fig. 3.

known as parallelism in elementary geometry is not unchanged by projection and cannot enter into projective geometry. From the visual point of view all lines seem to intersect. F. P. 2, F. P. 4, and F. P. 6 are subject to the same comment. From this it will be seen that the statements for projective geometry are much simpler than those for elementary geometry, inasmuch as no special cases or exceptions need be introduced to cover the possibility of parallelism. At first this might seem unnatural or even wrong, but it is in the true spirit of the subject and after a little usage appears as one of the principal beauties.

The expression is often used that parallel lines and planes meet "at infinity." This is convenient in expressing the relations of projective to elementary geometry (§ 7), but it must not be allowed to introduce confusion. There is no such thing as distance, much less infinite distance or infinity, in pure projective geometry. (See, however, § 8.)

4. *Harmonic Elements. Duality.*—A set of points situated upon a line is called a *range.* A set of planes passing through a line is called a *pencil* of planes. A set of lines lying in a plane and passing through a point is called a *pencil* of lines.

It may be said that the fundamental construction of projective geometry is the construction of a harmonic range. Given a pair of points A, B on a line (Fig. 4) and a third point C. To find the fourth harmonic point D draw through C any line. In the same plane draw AE and BE cutting the line through C in F and G. Join F to B and G to A by lines intersecting in H. Draw the line connecting E and H, and let it cut the line AB in D. Then D is said to be the fourth harmonic point in the range $AB \cdot C$. It may be proved by the theorems given above that: 1° no matter how the construction be carried

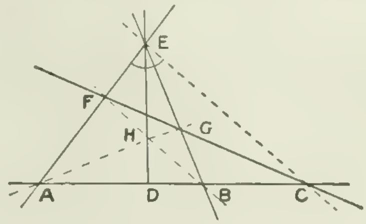


Fig. 4.

out, it always leads to the same point D; 2° if the three given points be $AB \cdot D$, the fourth harmonic is C, and hence the pair of points C, D may be said to divide the pair A, B harmonically; 3° the pair A, B also divide C, D harmonically, and hence the pairs $AB \cdot CD$ may simply be called harmonic pairs or a harmonic range.

A pencil of lines such as $E\text{-}AB \cdot CD$ which cuts a line in a harmonic range is by definition a harmonic pencil. It may be shown that if any line cuts a harmonic pencil, the range of points is harmonic. Similarly if a pencil of planes cuts one line in a harmonic range, it cuts every line in a harmonic range and is said to be a harmonic pencil. The harmonic property is thus evidently a true projective property, being unchanged by projection.

A characteristic of higher geometry is the frequent use of correspondences—that is, of methods for obtaining from a given group of theorems another group merely by substituting different words in the statement of the given theorem. The simplest of these correspondences is *duality.* There are several dualities established in projective geometry. Of these the most important are duality in space and duality in the plane.

Spatial duality is obtained by substituting respectively for 'point,' 'line,' 'plane,' the words 'plane,' 'line,' 'point,' and making such corresponding changes from 'pass through' to 'lie on' as may be necessary. In the fundamental propositions the duality appears. Thus F. P. 1 and F. P. 2 are dual statements. The same is true of F. P. 3 and F. P. 4 and of F. P 5 and F. P. 6. As this dual relation extends through all the fundamental propositions, it must extend through all propositions immediately derived from them. For, the proof of a dual proposition may be given by merely making in the proof of the given proposition the same changes as in its statement. As this may be done at every step, the two sets of propositions may be developed side by side, and the duality can never break down until the introduction of some additional definition or fundamental proposition which is not accompanied by its dual. Thus Th. 1 and Th. 2 are dual, and the proof of Th. 2 is the exact dual counterpart of the proof of Th. 1.

The duality in the plane may be obtained by substituting for 'point' and 'line' the words 'line' and 'point.' A 'range of points' becomes a 'pencil of lines' and *vice*

versa. Thus Th. 1 and Th. 4, and in case the construction be confined to a plane Th. 5 and Th. 6, are duals. According to the definitions above given it did not appear that the harmonic pencil was the dual of the harmonic range. It is, however, possible to give for a harmonic pencil a construction which is the dual of that given for the range, and it may be proved that this construction is equivalent to the earlier definition. Therefore all theorems concerning harmonic properties have dual counterparts.

If four lines no three of which pass through the same point be drawn in the plane, they will intersect in six points. This figure is called the *complete quadrilateral* (the heavy lines of Fig. 4, except *ED*. The three dotted lines are the three diagonals). In a dual manner the six lines which may be drawn through four points (no three of which lie on a line) in the plane constitute the *complete quadrangle.* The properties of these two figures are much studied in plane projective geometry.

5. *Order, Continuity, Projectivity, Correlation.*—If three lines a, b, c, lying in a plane, pass through a point, they determine a certain *order* in which the pencil may be conceived as described by a movable line—the order *abc* to which *cba* is opposed. Two lines alone cannot determine the order of description: for it is possible to pass from one to the other in either of two ways. Similarly three points upon a line determine an order upon the line, and three planes through a line fix an order about that line: but two cannot (see § 7). Thus a new element, *order*, is added to the fundamental elements, point, line, plane. It is intuitively obvious that:

F. P. 7. Order is unchanged by projection. Thus if a point describe a range in the order ABC, its projection will describe the projected range $A'B'C'$ in the same order (see Figs. 1 and 2).

One more fundamental proposition, the so-called postulate of continuity, the importance of which is quite overlooked in all but the best and most recent works, may be stated as follows:

F. P. 8. If a line be ordered and if Y follow X in that order; if, moreover, the points of the segment XY be divided into two classes so that 1° every point of the segments belongs in one of the classes and 2° every point of one class precedes all points of the other class, then there must be a point Z in the XY such that every point which precedes Z lies in the first class and every point which follows Z lies in the second.

If one range may be obtained from another by successive projection, the two ranges are said to be projective. The relation between the ranges is called a *projectivity.* (Similar definitions cover the relations between ranges and pencils or between two pencils. For simplicity the treatment will be confined to ranges.)

Fundamental Theorem.—Three corresponding points A, B, C and A', B', C' determine uniquely the projectivity between two ranges. That three elements of one range may be projected into any three elements of another range may be seen from Fig. 2. That the projective relation is thereby uniquely determined follows from F. P. 8. In like manner the correspondence of four points, no three of which lie on a line, determines the projectivity between two planes (which may coincide); and five points determine the projectivity between two spaces (these must coincide).

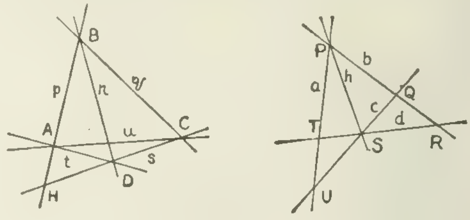


Plate I. Plate II.

Fig. 5

If the points of one plane are placed in correspondence with the lines of a second plane (which may be coincident with the first) in such a manner that to each point corresponds one line and conversely, and to the intersection of two lines corresponds the line joining their corresponding points, the relation is called a *correlation.* A correlation is completely determined by the correspondence of four given elements. (In the figure corresponding elements have the same letters.)

6. *Conics.*—If in one and the same plane a correlation be so established that when the point P corresponds to the line p, then conversely the line p corresponds to the point P, the correlation is called a *polarity.* Corresponding points and lines are *poles* and *polars* in the polarity. In general the poles do not lie on the polars: but certain of the poles do usually lie on their polars. The locus of the poles which lie on their polars is a curve to which the polars themselves are tangent and is called a *conic.* This definition is self-dual. A large number of theorems and their duals follow from the definition. For example, with their duals:

1. Pole, polar, and conic cut out a harmonic range on any line through the pole.

2. The locus of the intersections of corresponding lines of two projective pencils is a conic.

3. If a hexagon be inscribed in a conic, the points in which the three pairs of opposite sides intersect lie on a line.

This last is the famous Pascal's theorem, which with its dual, Brianchon's theorem, is very useful in the theory of conics. The second theorem is taken to define conic sections by many less modern writers. It is a very convenient graphical method. From it the various other properties may be deduced, though with much less directness and power than in the way here sketched. The first theorem is taken to define pole and polar by most of the writers who base conic sections on the second theorem. Another method of treating poles and polars is to consider projectivities not merely on a line but on a conic. The points of a conic are associated so that to each point A, B, C, . . . , corresponds a point A', B', C', . . . Three pairs of corresponding points determine the projectivity. If it so happens that A', B', C', . . . , correspond conversely to A, B, C, the projectivity is called *involutory* (just as the polarity

was the involutory correlation, § 4) or merely an *involution*. The study of involutions on a conic leads to an elegant theory of poles and polars.

Quadric surfaces may be defined analogously to conic sections. The treatment of cubic curves on such surfaces has been considerably developed. The treatment of plane curves of order and class higher than conics may be developed to some extent synthetically, but is generally carried on analytically (see CURVES, HIGHER PLANE). The linear and tetrahedral line complexes and certain line congruences have received synthetic treatment. The analytical discussions are, however, better known (see GEOMETRY, LINE-).

7. *Relations to Metrical Geometry.*—If the word meet be changed to meet or are parallel, every theorem of projective geometry becomes a theorem of metrical geometry. But in order conversely to interpret a metrical theorem as a theorem of projective geometry, it is first necessary to state the theorem in terms unchanged by projection—that is, in terms of double ratios (§ 1). This is usually done in one of two ways.

First, if the point D retreats indefinitely, AD/DC approaches -1 and the double ratio

$$\frac{AB}{BC} \div \frac{AD}{DC}$$

approaches the simple ratio AB/CB. Thus any ratio in metric geometry may be turned into a double ratio and rendered projective by adding the point at infinity upon the line to the three finite points A, B, C. In the particular case of a harmonic range (§ 4) $AB \cdot CD$ if D be at infinity, C bisects AB. This introduction of a point at infinity also accounts for the fact that a pair of points AB suffice in metric geometry to determine an order on the line (§ 5). The order is that of $AB\infty$.

The relation between metric and projective geometry may be used to obtain metrical theorems from projective theorems by specialization of the figure, or to obtain projective theorems from metrical by generalizing the figure by projection. Thus the theorems «the diagonals of a parallelogram bisect each other» and «a diagonal of a complete quadrangle is divided harmonically by the other two diagonals» may be obtained one from another. (See Fig. 4.)

Second, the double ratio of four lines a, b, c, d may be written as

$$\lambda = \frac{\sin \measuredangle ab}{\sin \measuredangle bc} \div \frac{\sin \measuredangle ad}{\sin \measuredangle dc}.$$

If only a simple angle such as $\measuredangle bd$ is given, the two other lines of the pencil may be assumed to be the «minimal lines» or «lines to the two circular points» determined by

$$x \pm \sqrt{-1}\, y = 0.$$

The double ratio λ becomes

$$\lambda = e^{2\phi i} = \cos 2\phi + i \sin 2\phi,$$

$$\phi = \frac{1}{2i} \log \lambda.$$

Thus an angle ϕ has been expressed in terms of a double ratio λ by the introduction of the two circular points. If, in particular, ϕ is a right angle, $\lambda = -1$, and the pencil is harmonic.

The properties of circular points most necessary to establish the relation of metrical to projective geometry are: They lie on the line at infinity. All circles pass through them. The lines (imaginary) joining the center of a circle to the circular points are tangent to the circle. Thus the theorem «the locus of the vertex of a right angle (or any angle) whose sides pass through two fixed points is a circle through the fixed points» becomes «the locus of the vertex of a harmonic pencil (or any pencil of constant double ratio) whose sides pass through four fixed points (two of these correspond to the circular points) is a conic section passing through the four fixed points.»

8. *Relations to Analytic and Non-Euclidean Geometry.*—The fact that in metrical geometry the point 1 upon a line is half-way between the points 0 and 2 furnishes a clue for constructing a projective scale purely by harmonic constructions. Let three points A, B, C be arbitrarily assigned the numbers 0, 1, ∞. By finding the fourth harmonic to 0 with respect to 1 and ∞, a point is constructed to which the number 2 is assigned. In like manner all the positive integers may be located. The negative integer $-N$ is assigned to the point harmonically situated with respect to $+N$ and the pair 0, ∞. By projecting 0, N, ∞ into 0, 1, ∞ the points $1/N$, $2/N$, . . . can be located. Thus all the rational numbers are assigned to points on a line. By use of F. P. 8 it may be shown that to each point of the line corresponds a number rational or irrational or ∞, and to each number corresponds just one point.

To obtain a system of coördinates for the plane, assume two lines in the plane. Mark their intersection as 0 and upon each of them mark arbitrarily the points 1, ∞. Then to

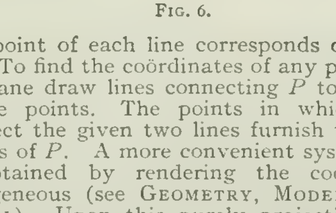


FIG. 6.

each point of each line corresponds one number. To find the coördinates of any point P of the plane draw lines connecting P to the two infinite points. The points in which these intersect the given two lines furnish the coördinates of P. A more convenient system may be obtained by rendering the coördinates homogeneous (see GEOMETRY, MODERN ANALYTICAL). Upon this purely projective basis all analytical geometry may be built up. The system is evidently that which is obtained by projecting the ordinary Cartesian system of coördinate axes into the system here assumed. In practically all treatises upon analytical geometry the coördinates are introduced as metrical quantities and are only later proved to be truly projective. Analytical projective geometry is closely related to Invariants and Covariants (q.v.), Geometry of Hyperspaces (q.v.), Modern Analytical Geometry (q.v.),

Higher Plane Curves (q.v.), and Determinants (q.v.).

Projective geometry includes in itself not only metrical geometry, but the ordinary non-Euclidean geometries as well. This is seen from examining the fundamental propositions upon which those geometries are based, or, better, by following the analytical method of A. Cayley (q.v.), and defining distance in the various geometries as the logarithm of a double ratio. (See GEOMETRY, NON-EUCLIDEAN.)

9. *New Problems and Bibliography.*—It may well be said that pure projective geometry, which rose with von Staudt in 1847 and was carried on by numerous investigators during the next fifty years, has now reached a stage that is near finality, and that new problems are likely to be on neighboring fields. Thus at present there is a great deal of work on the foundations of mathematics. For pure projective geometry this means the determination of one or more sets of postulates and fundamental concepts which shall be 1° projective, 2° complete, 3° compatible, 4° independent and irreducible, and 5° as nearly self-dual as possible. This problem is not yet settled in a wholly satisfactory manner, despite the researches of Pieri, Schur, Moore, and Veblen. The fundamental propositions assumed in earlier sections are far from satisfying rigorously all these conditions. They are, however, sufficiently good for most purposes.

The theory of involutory projectivities has been satisfactorily developed as far as its application to transformations which leave a quadratic form fixed is concerned, but for the general case there remains much to be done. And so with many other special problems which might be enumerated.

Of late Wilczynski has been developing a projective theory of curves and surfaces which, though not wholly in touch with pure projective geometry, promises valuable additions to the subject.

A complete bibliography of memoirs and books may be found in the historical account of the subject by Ernst Kötter, 'Die Entwickelung der synthetischen Geometrie,' the first volume of which appeared in 1901. The work is not yet complete. The same is true of the 'Encyclopedie der mathematischen Wissenschaften' (vol. III, Pt. 1). The following text-books may be cited: von Staudt, 'Geometrie der Lage' (1847); 'Beiträge zur Geometrie der Lage' (1856–1860); Reye, 'Geometrie der Lage' (1892–1899), partly translated by Holgate, 'Geometry of Position' (1898); Böger, 'Geometrie der Lage' (1900); Sannia, 'Geometria proiettiva' (1895); Enriques, 'Lezioni di Geometria proiettiva' (1898), translated into German, 'Vorlesungen über projektive Geometrie' (1903). From the older standpoint: Steiner, 'Vorlesungen über synthetische Geometrie' (1898); Cremona, 'Projective Geometry' (1893, translated by Leudersdorf); Poncelet, 'Traité des Projections' (1866); Duporcq, 'Premiers Principes de Géométrie modernes' (1899).

EDWIN BIDWELL WILSON,
Instructor in Mathematics, Yale University.

Geophagy, jē-ŏf'ajĭ, **Geophagism,** or **Dirt-eating,** the practice of eating some kind of earthy matter, as clay or chalk, common among uncivilized peoples, such as the South American Ottamacs, the Indians of the Hudson Bay country, the West Indian blacks, the negroes in some of the United States, and among the less civilized whites in the mountain districts of Tennessee and Kentucky. In some cases it is probably used to allay hunger, but it is also practised where the supply of food is sufficient. Among chlorotic young women a similarly depraved appetite is not uncommon.

George, surnamed «THE BEARDED,» duke of Saxony: b. 27 Aug. 1741; d. 17 April 1539. He was the son of Albert the Brave, the founder of the Albertine line of Saxony, and succeeded, in 1500, to the hereditary dominions of the Albertine house. Later on he became involved in the turmoils of the Reformation Period. He was not at first wholly hostile to reform, but thought that it could be better effected by means of papal edicts than by the revolt of Luther. Accordingly he became embittered by the uncompromising tone of Luther's later writings, and endeavored to suppress the Reformation in his dominions by violent measures. These, however, were unsuccessful, and in 1539, on the accession of his brother Henry, who was a Protestant, the Reformation was introduced into the dominions of the Albertine house of Saxony.

George, Saint, the especial patron of chivalry, and tutelary saint of England: d. Nicomedia 23 April 303. Though venerated both in the Eastern and Western Churches, his history is extremely obscure, the extant accounts containing very much less history than legend. The story in the 'Acta Sanctorum' ('Deeds of the Saints') is that he was born of noble Christian parents in Cappadocia, became a distinguished soldier, and after testifying to his faith before Diocletian, was tortured and put to death He was adopted by the Genoese as their patron saint, and in 1222 the Council of Oxford ordered that his day (the 23d of April) should be observed as a national holiday in England. In 1344 an order was instituted in his honor by Edward III., and in 1350 this was made the Order of the Garter, of which accordingly Saint George is the patron.

George I. (GEORGE LOUIS), king of Great Britain, and Elector of Hanover: b. Hanover, Germany, 28 March 1660; d. Osnabrück 11 June 1727. He was the son of the Elector Ernest Augustus, by Sophia, daughter of Frederick, elector palatine, and granddaughter to James I. In 1682 he married his cousin, Sophia Dorothea, daughter of the Duke of Celle. The union was not a happy one. George I. was both a faithless and a jealous husband, and when his wife, who was guilty of some imprudences, brought on herself the suspicion of carrying on an illicit intrigue with Count Königsmark, he caused her to be imprisoned, and kept her in confinement for the rest of her life. The offspring of the marriage were George, Prince of Wales, afterward George II., and Sophia, the mother of Frederick the Great. In 1698 he succeeded to the electorate, and in this succession was joined in the alliance against France. The command of the imperial army was conferred upon him in 1707, but owing to jealousies among his confederates he resigned the command at the end of three campaigns. At the Peace of Rastadt Louis XIV. recognized the electoral dignity in

the house of Lunenburg, as he had already by the Treaty of Utrecht recognized the succession of the same house to the throne of Great Britain, which event took place on the death of Anne in 1714, when the elector was in the 55th year of his age. His reign in England was disturbed first by a rising of the Scottish Jacobites in favor of the son of James II., and afterward by wars with Spain, undertaken first in conjunction with Holland and France (the Triple Alliance of 1717), afterward in addition with Austria (the Quadruple Alliance of 1718), with the view of checking the schemes of the Spanish minister Alberoni. George I. was plain and simple in his taste and appearance; he possessed much natural prudence and good sense, and his management of his Germain dominions, to which he showed more attachment than to his English dominions, was able. See Coxe, 'Life of Walpole' (1808); Wright, 'England Under the House of Hanover' (1848); Thackeray, 'The Four Georges' (1860).

George II. (George Augustus), king of Great Britain, son of George I.: b. Hanover 10 Nov. 1683; d. London 25 Oct. 1760. He married in 1705 Wilhelmina Carolina of Brandenburg-Anspach. In 1708, then only electoral prince of Hanover, he distinguished himself under the command of Marlborough. He came to England with his father at the accession of the latter, and was created Prince of Wales. He was made regent during the king's visit to the continent in 1716, but a political difference ensuing, he lived some time estranged from the court. This breach was finally accommodated, and in 1727 he succeeded to the throne. He inherited in full force the predilection of George I. for Germany; and the same system of politics and the same ministers continued to govern the nation after his accession as before it. In the earlier part of his reign, during the greater part of the ministry of Walpole, the neutrality of England was preserved during the wars on the continent. In 1739 the depredations committed by the Spaniards in America on the commerce of England led to war, which brought about the resignation of Walpole in 1742. England next took part in the war of the Austrian Succession, in which George II. himself shared, being present at the battle of Dettingen, in 1743. His reign is also memorable on account of the second Jacobite rising in Scotland in 1745–6, headed by Prince Charles Edward. In 1755 the disputes between Great Britain and France in relation to their respective boundaries in Canada produced hostilities in that country, and an open war between the two nations the following year. The events of this war, in which the principal powers of Europe became engaged, raised Great Britain, under the able auspices of Pitt (first earl of Chatham), to the pinnacle of power. George II. was a prince of very moderate abilities, parsimonious, and wholly regardless of science or literature; hasty and obstinate, but honest and open in his disposition. His queen, the cultivated and well-informed Caroline, acquired a great ascendency over him, which did not, however, prevent some of the irregular attachments so common with royalty. See Hervey, 'Memoirs of the Reign of George II.' (1854); Walpole, 'Memoirs of the Last Ten Years of the Reign of George II.' (1822–46); Schmucker, 'History of the Four Georges' (1860); Thackeray, 'The Four Georges' (1860); Jesse, 'Memoirs of the Court of England from the Revolution of 1688 to the Death of George II.' (1843).

George III., king of Great Britain: b. London 4 June 1738; d. Windsor 29 Jan. 1820. He was the eldest son of Frederick, Prince of Wales, by the Princess Augusta of Saxe-Gotha. On the death of his father in 1751, his education was entrusted to the Earl of Harcourt and the Bishop of Norwich; but the formation of his opinions and character seems to have been materially influenced by the maternal ascendency of the princess dowager, who was principally guided by the counsels of the Earl of Bute. George III., who had been previously created Prince of Wales, ascended the throne on the demise of his grandfather, George II., being then in his 23d year. In the following year he married the Princess Charlotte Sophia of Mecklenburg-Strelitz, a union which in its result operated materially on the domestic character of this reign. In 1763 the Seven Years' war was concluded by the Peace of Paris under the ministry of Lord Bute. In 1764 Mr. George Grenville, who had become premier by the retirement of the Earl of Bute, began those measures in relation to the American colonies, the consequences of which proved so momentous; and the Stamp Act was passed the following year. About the same time, in consequence of some appearances of the mental derangement of the king, a bill was passed to enable his majesty to appoint the queen, or any of the royal family residing in England, guardian to his successor, and regent of the kingdom. In 1766 the Rockingham administration repealed the American Stamp Act; at the same time passing a declaratory act asserting the right of taxing the colonies. The Rockingham cabinet was dissolved 30 July 1766, and succeeded by one formed by Pitt, now earl of Chatham. In 1768 Lord Chatham, disgusted with the conduct of his colleagues, resigned the privy-seal, and was succeeded by Lord Bristol. The same year was distinguished by the return of John Wilkes for Middlesex, and the popular tumults attendant upon his imprisonment and outlawry. In 1773 the discontents in America burst into an open flame, and a royal message, in the commencement of the session of 1774, called on Parliament to maintain the English supremacy. Notwithstanding the subsequent loss of an empire, George III., by the steadiness with which he put down the coalition administration, acquired a degree of popularity which never afterward entirely deserted him. The smooth course of the early years of the administration of Pitt materially added to this disposition, which exhibited itself very strongly when the constitutional malady of the king again displayed itself in 1789, and still more upon his subsequent recovery. In reference to the French Revolution, and the important contests which arose out of it, it is sufficient to remark that George III. zealously coincided in the policy adopted by his administration. A similar observation will apply to the domestic, and Irish and Indian policy of the Pitt cabinet; as also to the transactions connected with the Irish rebellion. George III. was immovable in his opposition to the demands of the Irish Catholics, and, seconded by the influence of the Church and the popular feeling, was enabled to eject

the Fox and Grenville administration, which succeeded on the death of Pitt. The proceedings of the Perceval administration, until the final retirement of the king in 1810, need not be detailed here; while the insanity of the monarch renders the interval which elapsed from his retirement to his death a blank in his biography. George III. possessed personal courage and steadiness of character in a high degree. Of a plain, sound, but not enlarged understanding, he acted upon his convictions with sincerity. His tastes and amusements were plain and practical. Literature and the fine arts engrossed but a small share of his attention, and hunting, agriculture, mechanical contrivances, and domestic intercourse, seem to have chiefly occupied his leisure. Religious, moral, and temperate, the decorum of his private life was always exemplary. His deportment as a father and a husband, according strictly with the national notions of propriety, rendered him and the queen a constant theme of praise; and the throne was regarded as a pattern in respect to the conjugal duties. See Walpole, 'Memoirs of the Reign of George III.' (1894); Massey, 'History of England During the Reign of George III.' (1855).

George IV. (George Augustus Frederick), king of England: b. London 12 Aug. 1762; d. Windsor 26 June 1830. He was the son of George III. and the Princess Charlotte of Mecklenburg-Strelitz. His dissipated life, his extravagance, his supposed marriage with a Roman Catholic, Mrs. Fitzherbert, and his connection with the most prominent members of the Opposition, alienated from him the affection of his father and the esteem of the nation. In 1795 he consented, on condition of the payment of his debts, to marry the Princess Caroline of Brunswick, but he soon began to treat her with neglect, and after the birth of their daughter, Charlotte Augusta, abandoned her. (See Caroline Amelia Elizabeth.) On 3 Feb. 1811, he was appointed regent, with limited powers, on account of the king being attacked the previous year by a repetition of the mental malady to which he was subject. The Whigs, his former friends, now hoped to come into office, but the prince showed a sudden change of sentiments, and maintained the Perceval ministry in power. The distress caused by the interruption of the demand for manufactures, and the high price of the means of subsistence after the general peace of 1815, occasioned great discontent among the people, and the violent measures adopted by the government increased the unpopularity of the regent, upon whose life an attempt was made in 1817 when he was going to open the session of Parliament. In 1820 he became king, on the death of George III. In February 1827, Canning became head of the government. The most important event after his attaining the throne was the passing of the Catholic Emancipation Act, by the Wellington ministry, in 1829. George IV. left no descendants, his only daughter, the Princess Charlotte, wife of Leopold of Saxe-Coburg, having died childless in 1817. He was therefore succeeded by his brother William, Duke of Clarence (William IV.). See McCarthey, 'History of the Four Georges and of William IV.' (1884-1901); Thackeray, 'The Four Georges' (1860); Cooly, 'Life of George IV.' (1830); Lady Bury, 'Diary of the Times of George IV.' (1838).

George I., king of Greece, with the title, King of the Hellenes: b. Copenhagen 24 Dec. 1845. He was second son of the king of Denmark. In 1863 he was elected king by the Greek National Assembly. In 1867 he married the Princess Olga, a niece of the Russian czar. His conduct as a constitutional monarch has been always correct and regular, and he won the popular sympathies by the efforts he made on behalf of the expansion of Greek nationality. His children have been bred in the Greek faith.

George V., king of Hanover: b. Berlin 27 May 1819; d. 12 June 1878. He was son of Ernest Augustus. He ascended the throne of Hanover in 1851; in the war between Prussia and Austria in 1866 took side with the latter, and in the same year was removed by Prussia, which annexed the kingdom on 20 September. As ex-king he assumed the titles of Duke of Cumberland and Teviotdale (Great Britain) and Earl of Armagh (Ireland).

George II., duke of Saxe-Meiningen: b. Meiningen 2 April 1826. He was educated at Bonn, received the commission of major in the Prussian cuirassier-guards, succeeded to power upon the abdication of Duke Bernhard, his father, in 1866, and served in the Franco-German war as Prussian general of infantry. Assisted by the manager Cronegk he did much to improve the artistic presentation of German drama.

George, prince of Denmark: b. 1653; d. 1708. He was son of King Frederick III., and husband of Queen Anne of England. He sided with William of Orange in the Revolution of 1688, and received the title of Duke of Cumberland. Later he became grand-admiral. From his favorite exclamation he was jocosely known as *Est-il-possible*.

George, Greek prince, 2d son of George I., king of the Hellenes: b. Corfu, Ionian Islands, 25 June 1869. He was appointed lieutenant in the Greek navy 19 July 1889. While traveling in Japan, in 1891, with his cousin, the grand-duke (afterward Nicholas II.) of Russia, he rescued the latter from death at the hands of a religious fanatic. He was appointed high commissioner in Crete in December 1898.

George, duke of Clarence, and brother of Edward IV., king of England; d. 1478. He espoused the cause of Henry VI. and his queen, Margaret of Anjou, against his brother and sovereign. Some years afterward he was accused of having sought the hand of Mary, duchess of Burgundy. He subsequently married a daughter of the Earl of Warwick (the "king-maker"), and joined him in his revolt against the royal authority. Being taken prisoner, he was condemned to death. The unfortunate prince, being allowed to choose the mode of his death, is said to have drowned himself in a butt of Malmsey wine.

George, Ernest, English architect: b. London 13 June 1839. He studied at the Royal Academy and received the queen's gold medal of the Royal Institute of British Architects in 1896. He has conducted extensive restorations, etc., at Welbeck Abbey and has built various

country-seats and churches in Devon, Hertfordshire, and other parts of England.

George, Henry, American political economist: b. Philadelphia 2 Sept. 1839; d. New York 29 Oct. 1897. He made his way to California as a sailor in 1858, and worked there as a printer for several years, until he became a reporter for the San Francisco *Times,* and in 1867 the editor of the same paper. In 1871 he published 'Our Land and Land Policy' in which he advocated the single tax theory, later developed more fully in 'Progress and Poverty' (1879). In this latter work, he not only explained his policy of land taxation (see SINGLE TAX), but also attacked the doctrine of Malthus (q.v.), and the "wages fund" theory, advancing the theory that the wages of labor are paid out of the value that the laborer creates, not from a "fund" of capital. The book did not at once attract much attention, and was first widely noticed in England; later attaining great popularity in this country. George visited England in 1880-1, and on his return settled in New York, where he devoted his time to writing, and agitation and organization for the single tax movement. In 1886 he was nominated for mayor of New York by the United Labor party, but was defeated, though receiving over 67,000 votes. In 1897 he was again nominated for mayor and took an active part in the campaign, but died before election day. His works, besides those already mentioned, include: 'The Irish Land Question;' 'Social Problems' (1883); 'Property in Land;' 'The Condition of Labor;' 'Protection or Free Trade' (1886.

George, Hereford B., English writer: b. Bath, Somerset, 1838. He was educated at Winchester and Oxford, was called to the Bar in 1864 but returned to Oxford in 1867, and was tutor at New College, Oxford, till 1891. He has published: 'The Oberland and Its Glaciers;' 'Genealogical Tales Illustrative of Modern History;' 'Battles of English History;' 'Napoleon's Invasion of Russia;' 'The Relations of Geography and History;' etc.

George, James Zachariah, American politician: b. Monroe County, Ga., 20 Oct. 1826; d. Mississippi City, Miss., 14 Aug. 1897. He fought in the ranks in the Mexican war, afterward studied law, became brigadier-general in the Confederate army during the Civil War, and in 1879-81 was chief justice of the supreme court of Mississippi. In 1880 he was elected to the United States Senate as a Democrat, and in 1886 and 1892 was re-elected. As a jurist he aided in drafting the present State Constitution of Mississippi, and in the Senate he was well known as an orator.

George, William Reuben, American philanthropist: b. West Dryden, N. Y., 4 June 1866. From 1880 he was in business employment in New York. His study of conditions among poor children resulted in the formation of the George Junior Republic (q.v.), of which he became director.

George Eliot. See ELIOT, GEORGE.

George Sand. See SAND, GEORGE.

George Junior Republic, the community established (1895) near Freeville, N. Y., by W. R. George (q.v.) as a method of reform in the treatment of dependent and delinquent children. The organization is that of a miniature republic, with a constitution and machinery of government based on that of the United States. Originally the founder was president with other adults in the more important posts, but from 1896 all offices have been held by citizens. Each citizen may work for the founder or for other citizens who contract for labor. All purchase is made by the Republic's aluminum coin, later redeemed by United States currency. School is held, and farming, carpentry, printing, care of the establishment, dressmaking, domestic service, and cookery are the other activities followed. The entrance age is from 12 to 18.

George, Lake, in the eastern part of the State of New York, is one of the most beautiful, noted, and picturesque lakes in the world. It is fed mostly by ice cold springs, there being less than half a dozen living streams flowing into it. Its outlet is Lake Champlain in the Saint Lawrence river basin. It is the headwaters of one of the most noted of the Saint Lawrence valleys. It narrows at its outlet and the waters enter Lake Champlain by a short creek, which has a descent of about 230 feet in a mile with a series of cascades and an abrupt fall of 30 feet at Ticonderoga. Its length is about 36 miles, and it is 346 feet above the sea, and at its headwaters it is 247 feet above Lake Champlain.

In 1609 Champlain sailed up the lake which bears his name, and Indians told him of the beautiful water called Andiatarocti (Place Where the Lake Contracts) but there is no record that he ever saw Lake George. Father Jogues, a Jesuit missionary, first saw the lake on 29 May 1646, and because it was the eve of Corpus Christi he called it Lac du St. Sacrament, or Lake of the Blessed Sacrament, a name which it retained until it was changed by Gen. William Johnson, 28 Aug. 1755, and given that of Lake George, after George II. The name "Horicon" given it by Cooper, is an historical fraud, the creation of the novelist's brain.

This lake is on the direct route of travel which was used in the early days of exploration and colonization in journeying to and from Canada and New York. It was on the Great War Trail of the Nations, and was in turn under the control of the French, the English, and the Colonists, while our country was in its formative stage. During the French and Indian War, forts were built at Carillon (Ticonderoga) by the French, and at the head of Lake George (Fort William Henry, Fort George, and Fort Gage) by the English. It has been the scene of numerous bloody contests, between the whites and the Indians, the French of Canada and the English of the colonies. The encounter known as the "Battle of Lake George" occurred 8 Sept. 1755, between the French and Algonquins under Baron Dieskau, and the English and Iroquois under Sir William Johnson, with an Indian chief, King Hendrick, in charge of the Indians. A monument commemorative of this battle was unveiled at Lake George 8 Sept. 1903. It consists of heroic figures of Sir William Johnson and Chief Hendrick, designed by Albert Weinert. The State of New York has purchased here a large tract of land, containing the battlegrounds and Fort George, the reservation being known as "Battle Park." A few miles to the south King Hendrick fell, while a monument marks the spot where Col. Ephriam

Williams, founder of Williams College, met his death. Among the more important were the siege by Montcalm, capture and massacre at Fort William Henry 9 Aug. 1757; the gathering of Lord Abercrombie's great army, its defeat, and death of Lord Howe at Ticonderoga, 5-8 July 1758; the building of Fort George, advance down the lake and capture of Fort Ticonderoga by Lord Amherst, July 1759; capture of Fort Ticonderoga by Ethan Allen, May 1775; removal of guns and stores over the lake, winter of 1775-76 to Boston by Col. Henry Knox; and occupancy by American forces, spring 1776, followed by devastating smallpox epidemic; seizure by General Burgoyne, summer 1777; unsuccessful attack on Diamond Island by Americans under Colonel Brown on English forces, 22 Sept. 1777; capture of Fort George by Major Christopher Carlton (English) Oct. 1780; visit of General Washington and staff, July 1783.

The State has bountifully stocked its waters with fish. Deer, black bear, rabbits, partridges, foxes, minks, and rattlesnakes are to be found among its mountains, and ducks, eagles, gulls, and all kinds of wild birds fly above its waters. The lake is surrounded by mountains, the most striking of which are Prospect (1,800 ft.), Buck (2,000 ft.), Tongue, with its succession of mounts, Erebus, Shelving Rock, Black (2,315 ft.), Anthony's Nose, named after Anthony Wayne, and Rogers' Slide, after the fabled exploit of Rogers the Ranger, in 1757-58.

Lake George has more than 200 islands, among the largest of which are Long and Big Burnt Islands; Dome Island is the highest, Green Island is the most beautiful, and Diamond the most celebrated historically and sentimentally; Tea — so-called from «a tea house» erected there in 1828; Recluse and Floating Battery, occupied by Abercrombie 1758; Fourteen Mile, used by Burgoyne's forces for camping purposes; Harbor Islands, scene of a bloody conflict 25 July 1757 between French and Indians and English; and Prisoners', at foot of lake, used by the French as a place of confinement for captives. «The Narrows,» half way down, are narro passages in the lake, filled with large and small islands, known generally as the «Hundred Islands.»

There are many indentations in the lake line, some forming large bays. The best known are Dunham's, Kattskill, Bolton, Northwest, in itself a considerable lake; Fourteen Mile, and Paradise, the most beautiful bay in the world. The lake is well served by three fine steamers run in connection with the D. & H. Railroad and Champlain Transportation Line. The principal villages on the lake are — Lake George, at the head, located in the town of Caldwell (pop. [1900] 534); Bolton Landing, and Hague, near which are the Dixon graphite mines, the largest of their kind in existence. The ruins of Fort Ticonderoga (q.v.) are not far from the foot of the lake. Geologically, Lake George is thought to be a formation of the glacial age. To the mineralogical expert specimens of value are readily accessible in the surrounding mountains. Garnets, resinites, cocolite, pyroxene, sphene, graphite, and tourmaline are found at Rogers' Slide; feldspar, hermatite at or near Anthony's Nose; while the beach sands contain powdered garnet, amethyst, crystal quartz, magnetic sand, and epidote; on Diamond Island are found quartz crystals; gold in nonpaying quantities has also been discovered.

James A. Holden.

George, Order of St. See Garter, Order of the; Orders (Royal): *Russia, Bavaria, Hanover, Sicily, Great Britain.*

Georgetown, capital of British Guiana, situated on the eastern side of the Demarara River, at its mouth, with the Caribbean Sea for a second frontage. The city covers an area of 1,200 acres. Nearly every building is isolated from its neighbor and surrounded by palms, shrubs, or forest trees. The streets cross each other at right angles; those which run north and south in some cases have long canals in the centre, beyond which are the roadways — the width of such streets being more than 100 feet. On Main (or High) street are situated the town-hall, Victoria law courts, police magistrate's office, Colonial Bank, Presbyterian Church, Portuguese Roman Catholic Church, and the Methodist Church. The public buildings, where the Court of Policy sits, and the Anglican Cathedral are also in this section. Another fine street is the Brick Dam, the two rows of houses in which constituted the entire town of Stabroek before the colony was captured by the British. The finest building in the colony, the Roman Catholic Cathedral, stands a short distance east of this street. The Royal Mail Company, with its fortnightly mail service, makes the port of Georgetown a terminus; boats of the French Compagnie Generale Transatlantique call monthly on the way to Cayenne; the Dutch Mail does the same when going to Surinam; and steamers of a Canadian line also call every fourth week. Vessels drawing more than 20 feet cannot cross the bar at the mouth of the river, and those of even lighter draught are obliged to wait for high water. A line of steamers subsidized by the government makes daily trips from Georgetown to Essequebo; three times a week a steamer runs to Berbice; twice a week up the Demarara and Berbice rivers; and there is fortnightly communication by boat with Morawhanna, the capital of the northwestern district. A railway connects Georgetown with Mahaica, on the east coast. The West India & Panama Telegraph Company also puts the city and colony in communication with other countries. There are good street-car and telephone services. The city water, brought from creeks 20 miles distant through the Lamah Canal, is chiefly valuable in case of fire; it is not sufficiently pure for household use. The city is lighted by gas and electricity. Municipal affairs are managed by a mayor and town council. The value of real property is nearly $8,000,000; the portion held by Europeans and creoles (other than Portuguese) being valued at $4,611,575; the portion held by Portuguese at $1,938,370; by East Indians, $101,930; and by Chinese, $45,750. The tax-rate is usually 2 per cent per annum on the appraised value of private property. There is a well-equipped and trained fire brigade. Among the important institutions are the Royal Agricultural and Commercial Society, which has a library of over 17,000 volumes, and maintains reading-rooms, etc.; the Institute of Mines and Forests, and the Chamber of Commerce. Of the newspapers, one is

issued daily, and a number weekly, bi-weekly or tri-weekly. The port is regarded as healthy. There were two or three severe attacks of yellow fever half a century ago; but since that time the drainage has been improved, and the neighborhood of the wharves kept clean, and during the past 50 years only one serious outbreak has occurred. The number of inhabitants is given as 53,176. (See GUIANA, BRITISH.) Consult Rodway, 'Handbook of British Guiana.'

MARRION WILCOX,
Authority on Latin-America.

Georgetown, Col., a town and the county-seat of Clear Creek County; situated, at an altitude of 8,475 feet, in a picturesque valley in the heart of the Rocky Mountains, 52 miles west of Denver on Clear Creek and the Colorado & Southern railway. It is the centre of an important silver district, and has also important gold-mining interests. There are several public parks, and gas, water, and electric-light plants. Pop. (1900) 1,418.

Georgetown, Del., a town and the county-seat of Sussex County, 40 miles south by east of Dover; on the Philadelphia, Wilmington & Baltimore railway. It is situated in an agricultural section. The chief interest is the canning industry. Pop. (1890) 1,353; (1900) 1,658.

Georgetown, D. C., at one time a town in the District of Columbia; now included within the limits of Washington (q.v.), and sometimes called West Washington. It was at the head of Potomac navigation, and the port of entry for the District of Columbia.

Georgetown, Ky., a city and the county-seat of Scott County, 12 miles north of Lexington and 20 miles east of Frankfort; on the Frankfort & C., the Cincinnati, N. O. & T. P., and the Louisville S. R.R.'s. It is in the heart of the "blue grass" region, and the centre of an important stock-raising and agricultural district. Flouring-mills, brick-works, and other industries are also located here. Georgetown College (q.v.) is here situated. The "Royal Spring," which rises in the centre of Georgetown and furnishes about 200,000 gallons of water per hour, supplies the municipal water plant and affords the power for the street railway, an ice plant, a flour mill, and other establishments. Georgetown was settled in 1776, incorporated in 1790, and received its charter in 1894. The government is administered by a mayor, chosen for four years, and municipal council, elected on a general ticket. Pop. (1900) 3,823.

Georgetown, Ohio, a village and the county-seat of Brown County, 42 miles east by south of Cincinnati and 7 miles north of the Ohio River; on White Oak Creek and the Cincinnati, Georgetown & Portsmouth railway. It is the centre of an agricultural region, the growing of tobacco being an especially important industry. There are also some manufactures, and blue limestone is quarried in the vicinity. Pop. (1900) 1,529.

Georgetown, Ontario, a town of Halton County, 25 miles west of Toronto; on Credit River and the Grand Trunk railway. The water-power is excellent. There are paper-mills, knitting-machine manufactories, and knitting and woolen factories. Pop. (1901) 1,313.

Georgetown, P. E. I., town and port on the eastern coast; by rail 39 miles east of Charlottetown. It is the chief winter port of the island. Pop. about 1,500.

Georgetown, S. C., a city and the county-seat of Georgetown County, about 55 miles northeast of Charleston; at the head of Winyah Bay and on the Georgetown & Western railway. It is a port of entry and a seaport of considerable importance, being the central market for an excellent agricultural region whose rivers, with a total navigable distance of 1,000 miles, empty into Winyah Bay. There are exports of rice, pine lumber, turpentine, fish, cotton, shingles, and other commodities. Georgetown was first settled about 1700 and was incorporated in 1805. The Marquis de Lafayette landed here at the beginning of his first visit to the United States (1784). The government is by a mayor, biennially elected, and a municipal council, chosen at large. Pop. (1900) 4,138.

Georgetown, Tex., a city and the county-seat of Williamson County, 30 miles north of Austin; on the San Gabriel River and a branch of the International & Great Northern railway. The surrounding region is an agricultural one. Georgetown has cotton-gins, cottonseed-oil mills, and planing-mills, and manufactories of plows, ice, harness, and woodwork. Here are located mineral springs whose waters are similar to those of the well-known springs at Karlsbad, Germany. Georgetown is also the seat of Southwestern University, an institution of the Methodist Episcopal Church, South, founded in 1873. It was settled in 1854, incorporated in 1874, and is governed by a mayor and council, biennially chosen. Pop. (1900) 2,790.

Georgetown College, Ky., a coeducational institution in Georgetown, founded in 1829 under the auspices of the Baptist Church; reported at the close of 1900: Professors and instructors, 19; students, 360; volumes in the library, 12,000; productive funds, $235,000; grounds and buildings valued at $194,000; income, $23,500; number of graduates, 580.

Georgetown University, D. C., an institution of higher education, under the direction of the Roman Catholic Church. The plan of the institution was undertaken as early as 1785 by the Rev. John Carroll, later first archbishop of Baltimore. In 1786 the corporation of clergymen in the chapter held at Whitemarsh, Md., adopted a series of resolutions directing the establishment of the institution and the erection of its first building. The year 1789 is generally considered the year of the foundation of the university, though students were not received until 1791. Upon the reorganization of the Society of Jesus in Maryland in 1805, the Georgetown College, as it was then called, was transferred to that society, under whose direction it still remains. In 1815 the university was empowered by act of Congress to confer any degree in the arts, sciences, and liberal professions which are conferred in other colleges and universities, and, in 1833, the Holy See empowered the university to confer, in the name of the Church, degrees in philosophy and theology. The university is composed of the college; the school of medicine, organized in 1851 and including since 1901 a school of dentistry;

and the school of law, organized in 1870. The college comprises three distinct departments, the graduate school, the undergraduate department, and the astronomical observatory. A preparatory department is also connected with the university. The teaching of the university is guided by the principles of the Ratio Studiorum, formulated by the Jesuit order, and a strict standard of scholarship is maintained. The facilities of the university include the Coleman Museum of Natural History, the Beauchamp Hughes Art Cabinet, and the Riggs Memorial Library. In 1904–5 there were reported a faculty of 140 and a student enrolment of 544.

George Washington University, The (formerly Columbian), a non-sectarian university with graduate departments for post-graduate and professional studies, and colleges conducting undergraduate, technical, and specialized work, located in Washington, D. C.; organized by special act of Congress in 1821 and by special amendatory acts of Congress. The University is divided first into departments for graduate work: a department of arts and sciences leading to the masters' degrees and the degree of doctor of philosophy; a department of politics and diplomacy, leading to the degrees of master of diplomacy and doctor of philosophy; a department of medicine comprising a four-year course, leading to the degree of doctor of medicine, and a three-year course leading to the degree of doctor of dental surgery; a department of law and jurisprudence with a three-year course leading to the degree of bachelor of laws, a fourth year additional leading to the degree of master of laws, a graduate course of one year leading to the degree of master of patent law, and a three-year course for graduate students in arts and law, leading to the degree of doctor of jurisprudence; Columbian College for undergraduates with courses leading to the degrees of bachelor of arts and bachelor of science; Washington College of Engineering, with courses for undergraduates leading to the degrees in engineering; and a division of architecture with courses for undergraduates and graduates leading to the degrees in architecture.

By an act of Congress amending the charter, approved 3 March 1905, colleges may be organized under the charter of the University upon independent financial foundations, but educationally a part of the University, for educational work in arts, sciences, liberal and technical knowledge. The University reported (1904–5): professors and instructors, 186; pupils, 1,408.

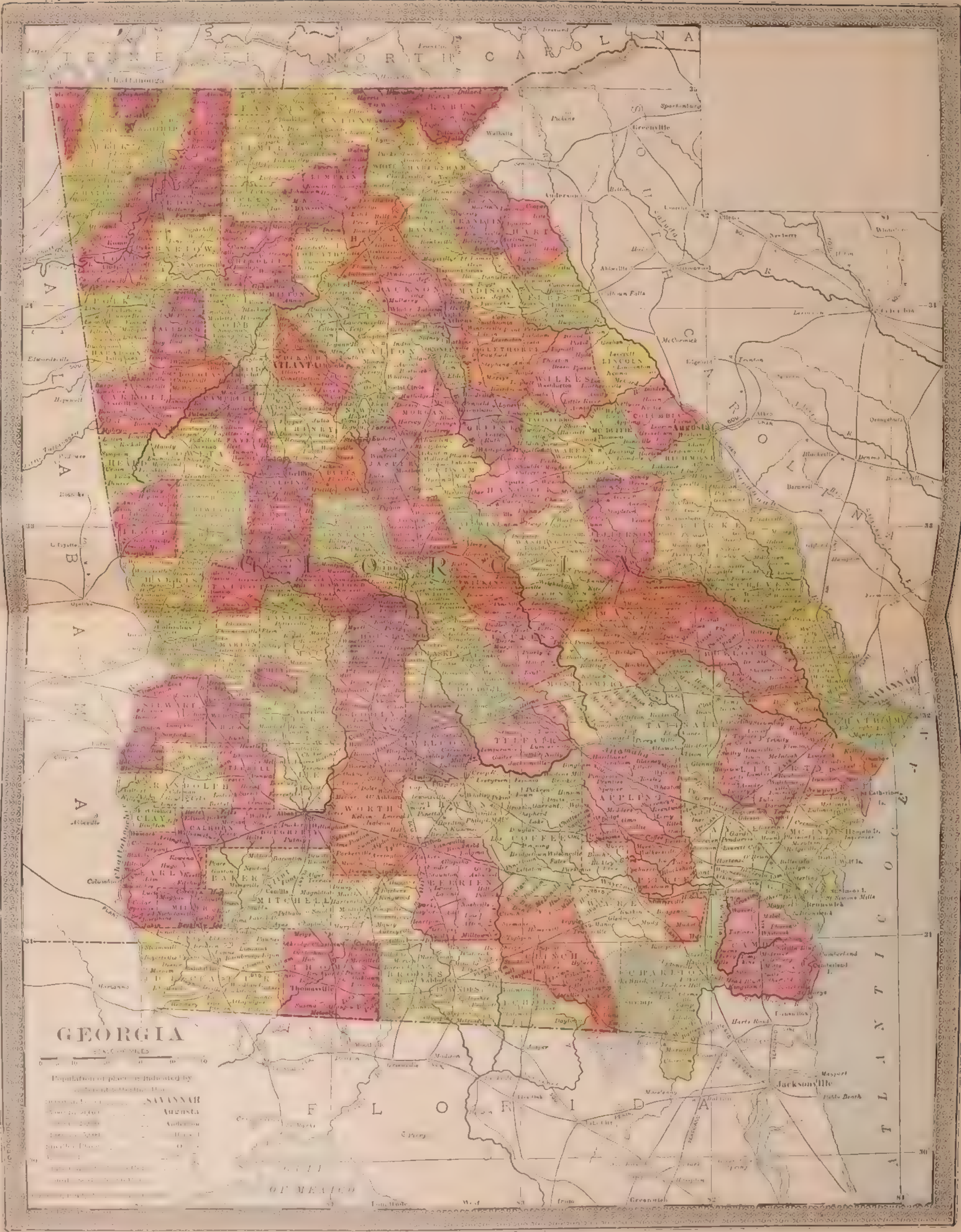
Otis D. Swett,
Registrar.

Georgia, in Europe (by the Russians called Grusia, by the natives Karthli), formerly a kingdom, but now included in the Russian government of Tiflis and Kutais, though the name is sometimes loosely employed to designate a much larger portion of the territory possessed by Russia south of the Caucasus. Area, in the latter sense, about 34,000 square miles; of Georgia proper, about 15,000 square miles; pop. 2,110,000. The history of the Georgians first becomes trustworthy about the time of Alexander the Great, to whom they became subject. After Alexander's death, in 323 B.C., they gained their independence under Pharnvas. The country was then governed by various dynasties of kings. Christianity was introduced toward the close of the 4th century; soon after the death of Mohammed, numerous followers of his entered the country and compelled the inhabitants to accept Islam. In the 11th century Georgia was twice invaded by the Seljuk Turks, and in the 13th, after widespread devastation, was captured by the Mongols under Timur. The Mongols were expelled in 1403 by George VII. In the 16th and 18th centuries Georgia was harried by the Persians, and at the same time the Turks were continually making encroachments. Aga Mohammed Shah in 1795 razed Tiflis to the ground, the king, Heraclius II., abandoning all resistance and taking refuge in the mountain fastnesses. In 1799 George XIII. formally resigned the crown in favor of the Emperor Paul of Russia, and in 1801 Russia annexed the country. Consult: Brosset, 'Eléments de la Langue Georgienne' (1837); Chubinov, 'Russian-Georgian Dictionary' (1846; new ed. 1886); Leist, 'Georgische Dichter Verdeutscht' (1887); Wardrop, 'The Kingdom of Georgia' (1888). See Georgian.

Georgia, the last settled of the 13 original States of the American Union; bounded on the north by North Carolina and Tennessee, on the northeast by South Carolina, on the east by South Carolina and the Atlantic Ocean, on the south by Florida, and on the west by Alabama; capital, Atlanta; area 59,475 square miles, of which 495 are water. Pop. (1900) 2,216,331, of which the white population numbers 1,181,109 and the colored 1,034,998.

Topography.— The northeastern part of Georgia is traversed by that part of the Appalachian chain of mountains known as the Blue Ridge, which in Georgia has an altitude of from 3,000 to 5,000 feet above sea-level. After running one third the distance across the State, it terminates abruptly, but appears again in short ranges and detached peaks. Northwest Georgia, the limestone region embracing about 3,600 square miles, has an altitude ranging from between 600 and 700 to 2,500 feet above sea-level. About 6,000 square miles of northern Georgia are above the altitude of 1,000 feet. About 20 miles to the west of the Blue Ridge lies the Cohutta Range, a continuation of the range known in Tennessee as the Unaka. The Cohutta has an altitude of 3,000 feet above sea-level with an abrupt escarpment toward the valley of the Oostenaula on the west, and then continues into Alabama in a low elevation called Dugover Mountain. To the northwest are Lookout and Sand Mountain ranges, which with their table-lands constitute a part of the Alleghany range, which, like the Blue Ridge, belongs to the great Appalachian system.

High Point, the loftiest part of Lookout Mountain, has an elevation of 2,408 feet. Its northeastern spur, called Pigeon Mountain, has an elevation of from 1,800 to 2,000 feet above the sea, its highest point rising to 2,331 feet. Another spur of Lookout, called Round Mountain, has an elevation of over 2,200 feet. Taylor's Ridge and its prolongation, called the White Oak Mountains, rise to an elevation of from 1,300 to 1,500 feet above sea-level. A little farther south, Rocky Face Ridge, with an elevation of from 1,500 to 1,700 feet, forms the


GEORGIA
NORTH CAROLINA
ALABAMA
FLORIDA
ATLANTIC OCEAN
GULF OF MEXICO
ATLANTA
Augusta
Savannah
Jacksonville
Columbia
Greenville
Chattanooga

eastern watershed of Chickamauga Creek (or river, as it is sometimes called), which flows through the valley at an elevation of 900 feet above the sea. There are several detached peaks, among which the most noted are Pine, Lost, and Kennesaw Mountains, the last named with its double peak rising to the height of 1,809 feet. In De Kalb County, 14 miles east of the city of Atlanta, in a comparatively level country, Stone Mountain, a vast mass of granite, rises to the height of 1,686 feet.

One of the most prominent features of northeast Georgia is the Blue Ridge chain of mountains, already mentioned. Some of the peaks of this chain rise to an elevation of 5,000 feet. The following is a list of the most noted of the mountain peaks of Georgia with their height above the level of the sea: Sitting Bull (middle summit of Nantahela) in Towns County, 5,046 feet; Mona (east summit of Nantahela) 5,039 feet; Enota in Towns County, 4,797 feet; Rabun Bald, in Rabun County, 4,718 feet; Blood, in Union County, 4,468 feet; Tray, in Habersham County, 4,403 feet; Cohutta, in Fannin County, 4,155 feet; Dome, in Towns County, 4,042 feet; Grassy, in Pickens County, 3,290 feet; Tallulah, in Habersham County, 3,172 feet; Yona, in White County, 3,167 feet. In all the mountain section of Georgia are charming valleys abounding in very productive lands. The most noted are Cedar, Texas, Broomtown, and Vann's valleys in northwest Georgia, and Nacoochee (Evening Star) and Santee valleys in the northeast section of the State. Among the interesting features of northwest Georgia are numerous caves. Hardin's Cave, near Kingston, has chambers 20 to 30 feet high. Middle Georgia is the most thickly settled section of the State. With the exception of two mountains, this region varies in altitude from 180 to 500 feet, and in a few instances to 1.000 feet. Lands too steep for the plow are seldom found in middle Georgia.

South Georgia embraces more than half the area of the State and extends from the southern limit of middle Georgia to Florida and the Atlantic coast. Its altitude ranges from 100 to 500 feet. About 3,000 square miles of the coastal region have an elevation of 100 feet.

Rivers.— The drainage system of Georgia comprises nine basins. The Tennessee basin is drained by tributaries of the Tennessee River. The Mobile basin is drained into the Gulf of Mexico by the Coosa and Tallapoosa rivers, and their tributaries. The Apalachicola basin is drained by the Chattahoochee and Flint rivers. These, uniting in the southwestern corner of Georgia, form the Apalachicola River which, flowing through Florida, empties into a bay of the same name, an arm of the Gulf of Mexico. The Altamaha basin is drained by the Oconee and Ocmulgee rivers, which empty into the Altamaha, flowing into the Atlantic Ocean. The Ogeechee basin is drained by the Ogeechee River into the Atlantic Ocean through Ossabaw Sound. The Savannah basin is drained by the Savannah River and its tributaries into the Atlantic Ocean. The Ocklockonee basin is drained by the river of that name into the Gulf of Mexico through Ocklockonee Bay. The Suwanee basin is drained by the river of that name into the Gulf of Mexico. Although the Suwanee runs for the greater part of its course through the State of Florida, it rises in southeast Georgia, and two of its main tributaries, the Allapaha and Withlacoochee rivers, are streams of south-central Georgia. The Satilla and St. Mary's basin is drained by the Satilla and St. Mary's rivers. The Satilla is the more northern and enters the Atlantic through St. Andrew's Sound. The St. Mary's enters the Atlantic Ocean through Cumberland Sound. Between these rivers lies the noted Okefinokee swamp. Its numerous large rivers furnish the State with excellent water transportation. Although the extensive railroad lines have built up in Georgia flourishing cities and towns remote from any water highway, yet those which are upon navigable streams enjoy the advantage of a competing water line. The Savannah is the most important river of Georgia for the reason that over 18 miles of its course is navigable for ocean vessels. The Savannah is navigable for river steamboats to Augusta, 230 miles to the north. The Chattahoochee is navigable for steamboats from Columbus to the Apalachicola and through that stream to the Gulf of Mexico. Through its several steamboat lines Columbus has a considerable river trade. The city of Rome in northwest Georgia has besides its several railroad lines a fine river trade through the Oostanaula and the Coosa. Steamboats carry to Rome the productions of the Coosa valley, lumber, iron, grain, and cotton, and the staple products of the Oostanaula valley. Albany, in southwest Georgia, enjoys an extensive steamboat traffic by the Flint River. The St. Mary's River is navigable for the largest vessels up to and beyond the town of that name, which is nine miles from the ocean. The Satilla and Ogeechee are each navigable for some distance, but their advantages have not been utilized to any considerable extent. Other navigable waters of Georgia are the inlets and sounds, flowing between the mainland and the islands that skirt the coast from the Savannah to the St. Mary's rivers. Through St. Simon's Sound the largest vessels pass up the Turtle River, a short but deep stream, to the city of Brunswick, the second in importance of the ports of Georgia, being, like Savannah, the centre of a fine fruit and trucking section. Every section of Georgia is drained by rivers of considerable size, and is consequently a splendid agricultural country. Its numerous navigable streams, supplementing its great railroad system, conspire to give its people unusual advantages for both internal and foreign commerce.

Climate.— Of nine climate belts in the United States eight are represented in Georgia. The lowest of these eight belts in mean annual temperature is below 40°, the highest between 70° and 75°. The climate of less than 40° mean annual temperature is found only on some of the mountain peaks. On the sides of these mountains below the summit the mean annual temperature is between 40° and 45°, corresponding with upper New England and New York and the mountain region of Virginia. There is a still larger climate zone of between 45° and 50° which corresponds with that to be found in portions of New York, Pennsylvania, and Ohio. The zone of between 50° and 55° embraces a narrow strip which runs northward through North Carolina and Virginia up to New Jersey. The zone between 55° and 60° of mean annual temperature contains an area two or

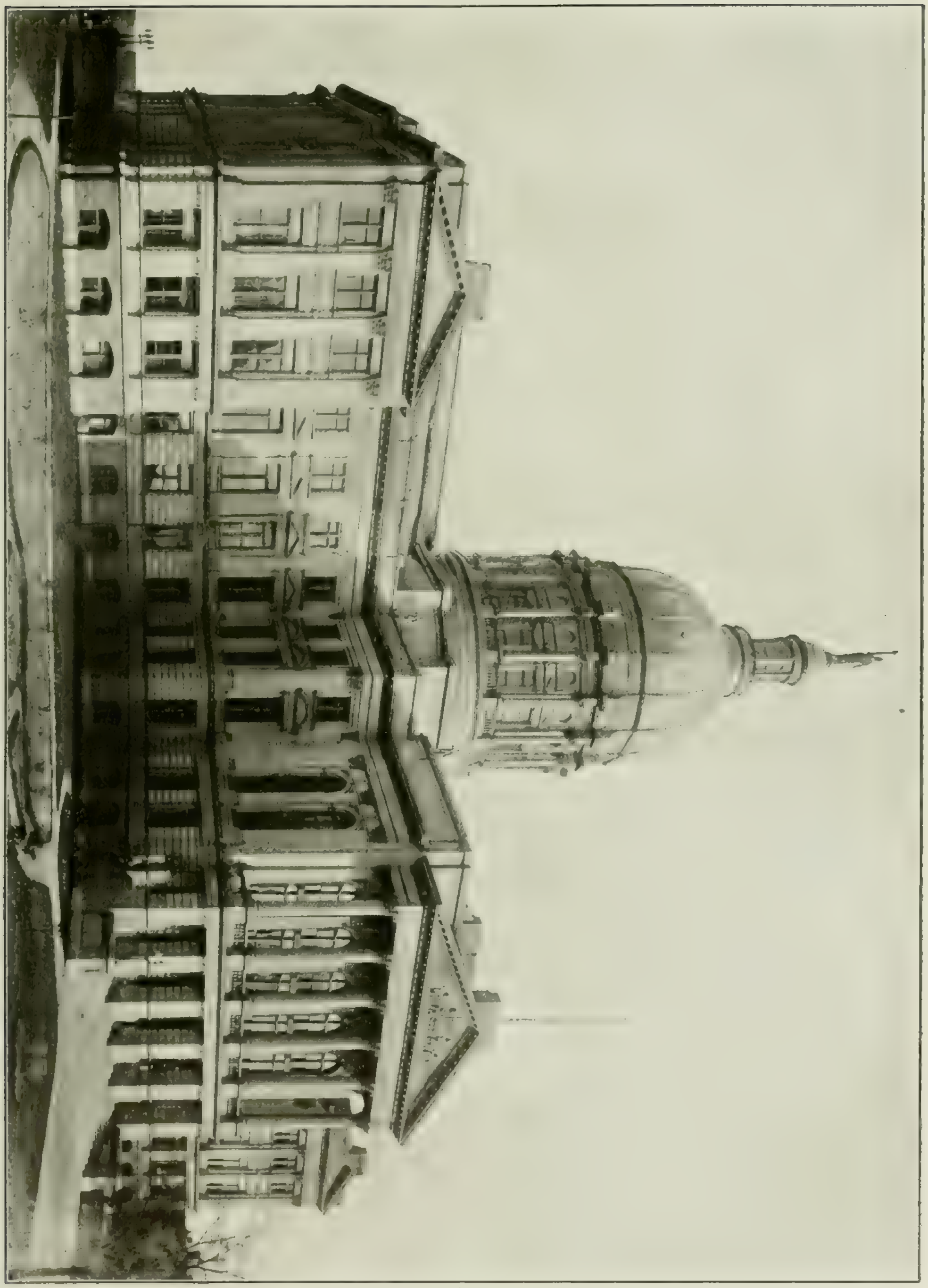
three times as large as all the preceding zones together and, passing through both Carolinas, ends in Virginia. The zone between 60° and 65° embraces nearly all of middle Georgia, corresponding with that of upper Alabama, Mississippi, Louisiana, Texas, West Tennessee, and Arkansas, and extends into Virginia. The mean annual temperatures at some of the important stations in this area are: Rome, 61.9; Gainesville, 61.3; Atlanta, 61.4; Carrollton, 62.; Athens, 63.; Augusta, 64.; LaGrange, 64.1; Thomson, 64.7.

The climate of southern Georgia is between 65° and 70° of mean annual temperature and corresponds with that of southern Texas, Louisiana, Mississippi, and upper Florida. At Macon it is 66.1°; Cuthbert, 68.1; Americus, 68.2; Brunswick, 68.7. Blackshear with 70.2° is the only station touching the zone between 70° and 75°. For the whole State the mean temperature for July is 81.8°. The isothermal line of 80°, July temperature, runs above Augusta and Macon to West Point. Above this line embracing the greater portions of north and middle Georgia the July temperature is between 75° and 80°. Below this line, embracing the greater part of East Georgia and nearly all of southeast and southwest Georgia the July temperature is between 80° and 85°. The climate of Atlanta, situated as it is on a ridge 1,050 feet above sea-level, corresponds with that of Washington, St. Louis, and Louisville, the winters being warmer and the summers cooler. Snow seldom falls in southern Georgia, and then rarely to a depth of more than two inches. In middle Georgia the fall of snow is a little more frequent and to a greater depth, while both its frequency and depth are greatly increased in the mountain region. The annual average rainfall of Georgia is 49.3 inches, the highest being at Rabun Gap, 71.7 inches, the lowest at Swainsboro, 39.4 inches. Atlanta's annual rainfall is 52.12 inches. The average for different sections of the State is: Middle Georgia, 49.7 inches; east Georgia, 41.4 inches, and northwest Georgia, 60.3 inches. The summer rainfall averages: For north Georgia, 13.6 inches; for southwest Georgia, 14.5 inches, and for the entire State, 13.4 inches. The summer rainfall averages at different localities: Rome, 10.2 inches; Atlanta, 10.8 inches; Rabun Gap, 15.4 inches; Americus, 16 inches; Brunswick, 16.6 inches.

Agriculture.— The northwestern section of Georgia presents a great variety of surface and soil. The slopes of the mountains and hills are well suited for the grazing of stock, and abundance of land, either rolling or entirely level in the valleys, is adapted to the raising of vegetables, fruits, corn, wheat, rye, oats, barley, buckwheat, cowpeas, clover, timothy, orchard grass, Bermuda, Johnson, crab, red top, and many other grasses useful for hay and pasturage. Cotton also is a profitable crop as far north as Floyd County, above which very little of this crop is raised. Some of the chief fruits are peaches, apples, pears, cherries, all kinds of berries and grapes of every variety. The forest timbers are oaks of several varieties, pines of two varieties, also the poplar, ash, beech, elm, chestnut, hickory, maple, walnut, iron wood, sugar berry, sycamore, sweet-gum, dogwood, persimmon, sassafras, wild cherry, rosebud, warhoo, cedar, and buckeye. In northeast Georgia but little over 12 per cent of the land is under cultivation, because this part of the State is thinly inhabited; but many of the tillable lands have a very rich, dark red soil. Little Tennessee valley in Rabun County and Nacoochee valley in White County are noted for fertility, bearing all kinds of crops, fruits, and grasses. About 75 per cent of the whole area known as middle Georgia is under cultivation. The central cotton region of the State includes the southern part of middle and large areas of southern Georgia. This region embraces the sand and pine hills belt, the red hills belt, and the yellow loam region. The first of these covers about 3,000 square miles, the other two about 12,000 square miles. Large crops of corn and cotton are raised throughout this area except in the sand hills belt. In the long-leaf pine region there are 17,000 square miles, and here the vast forests of long leaf pine are a great source of wealth to the State. Wherever the timber lands are cleared, they are being put under cultivation. The marls and swamp muck found in this section, when mixed, form a cheap and excellent fertilizer. The pine and palmetto flats around Okefinokee swamp furnish large quantities of long leaf pine, cypress, and saw palmetto, while along the creek-bottom and hummock lands are found these same trees, black-gum, tupelo-gum, titi, and maple. The coast region, about 2,045 square miles, includes the savannas, live-oak lands and islands. The coast lands from the Savannah to the St. Mary's River are noted for magnificent live oaks, also red and water oaks, red cedar, hickory, chinkapin, sassafras, cabbage and blue palmetto. Along the coast lands rice is cultivated, and the Georgia sea-islands produce the larger part of the finest cotton known to commerce. All over middle and southern Georgia grows the sugarcane, richer in saccharine matter than any other known plant from which sugar is extracted.

By reason of its more than 4½° of latitude and different altitudes of its various sections Georgia produces the crops and fruits of every section of the Union, and on its sea islands and extreme southern section of its mainland many of those of the tropics, such as oranges, lemons, bananas, etc. Pomegranates and figs are found all over the State.

The census of 1900 gives the total value of Georgia's agricultural products at $86,345,343. Of this amount $42,534,235 represented the value of the cotton crop, and $17,155,868 that of the corn crop. The sugarcane crop brought $1,690,704; Irish potatoes, $326,853; sweet potatoes, $2,354,390; miscellaneous vegetables, $3,009,306. But in that year both the cotton and corn crops were below normal in Georgia. The value of the peach crop that year was insignificant, because of unfavorable seasons. The normal value of Georgia's corn crop for several years has been in the neighborhood of $19,000,000, and in 1902 her cotton crop brought above $69,000,000, these two crops alone showing a greater value than all her agricultural products combined in the census year. The peach trees in commercial orchards number 16,000,000, of which over half are now in bearing. In a good fruit year the produce of these orchards brings into the State many millions of dollars. In any ordinary year the peach crop of Georgia is worth at least $4,000,000, and in some years it will far exceed those fig-



STATE CAPITOL AT ATLANTA.

ures. Georgia outranks all the States in the number and quality of her watermelons.

Stock raising is very profitable to those who engage in it. In southern Georgia cattle and sheep need very little shelter and for only a few weeks of the winter. The total value of all live stock on farms in 1900, including poultry, was $35,200,507 and the total value of all domestic animals not on farms was estimated at $2,281,059, making in all $37,481,566. The number of specified domestic animals on farms in 1900 was: Dairy cows, 276,024; other neat cattle, 623,467; horses, 127,407; mules and asses, 267,840; sheep (lambs not included), 258,894; swine, 1,424,298. Of poultry there were 4,549,144 chickens, 103,416 turkeys, 208,997 geese, and 64,895 ducks. The total value of all the poultry was $1,458,055. There were 187,919 swarms of bees valued at $242,769.

Geology and Mining.— There are three main geological divisions of Georgia. The Palæozoic in the northwest embraces the counties of Dade, Walker, Catoosa, Whitfield, Chattooga, Floyd, and the greater parts of Murray, Gordon, Bartow, and Polk. Cambrian, Silurian, Devonian, and Carboniferous formations are represented. The rocks are chiefly shales, sandstones, limestone, quartzites and cherts. This is a region of parallel valleys and mountain ridges in which are found valuable deposits of coal, iron, aluminum (or bauxite), manganese, and roofing slate. Hydraulic cement rock is found in large quantities in Bartow County. The crystalline area includes that portion of the State not in the Palæozoic area that runs north of a line extending through Columbus, Macon, Milledgeville, and Augusta. In this area are granites, schists, and gneisses, and in the region which borders both the Palæozoic and crystalline areas are found the marbles for which Georgia is so famous. The marble belt traverses Fannin, Gilmer, Pickens, and Cherokee counties, the most important quarries being in Pickens County. Large quantities of granite and gneiss are found in many localities in the crystalline area.

The gold deposits are found in four belts. The first runs through Rabun, Habersham, White, Lumpkin, Dawson, Forsyth, Cherokee, Cobb, Bartow, Paulding, and Haralson counties. The second belt traverses Rabun, Habersham, Hall, Gwinnett, Forsyth, Milton, De Kalb, and Fulton counties. A third belt traverses Cobb, Paulding, and Carroll counties. A fourth belt goes through Lincoln, Columbia, McDuffie, and Warren counties in the southeast part of the crystalline area. There are some irregular deposits in Towns, Union, Gilmer, Fannin, and Meriwether counties. The iron ores are in the Palæozoic area. The brown iron ores are mined in Bartow, Polk, and Floyd counties. The red iron ores are mined in Walker and Chattooga counties. Ochre occurs in Bartow County, manganese in Bartow and Floyd. The largest bauxite deposits are in Floyd and Bartow counties, but it occurs also in Polk, Walker, and Chattooga counties. Corundum deposits are found in Rabun, Towns, Union, Habersham, Carroll, and Heard counties. Laurel Creek mine in Rabun County near the Carolina line is the largest in Georgia, and one of the most noted in the United States. Pyrite is found in Lumpkin County; copper in Murray and Fannin counties, graphite near Emerson; asbestos in several localities in the crystalline area; talc in Murray, Fannin, and Cherokee; mica in Union and Fannin; barite in Bartow. Of precious stones amethysts are found in Rabun County, a few diamonds in Hall County, some good moonstones in Upson County. Rubies and sapphires of small size have been found in the northeast part of the crystalline area. The coal fields of Georgia are in Dade and Walker counties.

Limestone beds of good quality for both calcimining and building purposes are found in the Palæozoic area and in Hall and Habersham counties in the crystalline area. Limestone for calcimining is also found in different localities in the coastal plain region, which takes in all the southern portion of Georgia. In this region are found marls and phosphates. Through all that part of the State north of the fall line, which runs from Columbus through Macon to Augusta are found clays suitable for the manufacture of common brick and the coarser grades of earthen-ware, while immediately below the fall line in a narrow belt across the State are clays suitable for the manufacture of porcelain, enameled brick, china-ware, terra-cotta, sewer pipes, etc. The annual output of all the mineral products of Georgia is nearly $5,000,000.

Manufactures.— Georgia stands in the front rank of the Southern States in the variety and value of its manufactures and the number of its manufacturing establishments. The total value of all its manufactures by the census of 1900 was $89,789,656. The number of establishments engaged in the manufacture of cotton goods was reported as 68, with 817,345 spindles and 19,398 looms. The capital invested was $24,222,169. But in 1901, after a more searching investigation than ever before in regard to the growth of cotton spinning in the South, the United States Department of Agriculture reported that in 1899 there were 79 mills in operation and that in 1900 the number in operation had increased to 86 with 969,364 spindles. The same report stated that during 1900 there were completed 28 more mills and that the stock had been raised and plans prepared for 13 more. This report agrees very closely with one prepared early in 1901 by the Georgia department of agriculture, which gave a list of the mills by name and showed 111 mills in operation with 1,192,486 spindles and 26,645 looms. In bleached cotton goods Georgia stands fourth in the Union with 24,265,583 square yards. The cotton gins reported in the census of 1900 numbered 4,729 running for four months. Eli Whitney was living in Georgia, when he invented the cotton gin. The cotton oil mills in operation in 1901 numbered 58. They paid above $5,000,000 for cotton seed, which they manufactured into various products, valued at $14,000,000. The fertilizer factories registered with the commissioner of agriculture for the season of 1902 and 1903 numbered 82, many of them being of great capacity and having an immense trade all over the Southern States. In the manufacture of turpentine and rosin Georgia easily leads all the States, exporting in 1900 the vast amount of 14,623,328 gallons of spirits of turpentine and 1,408,928 barrels of turpentine, rosin, and pitch. In 1900 there were 1,254 establishments with a capital of $11,802,716 engaged in the lumber industry. Among the other manufactures the most impor-

tant are printing establishments, flour and grist mills, woolen mills, furniture factories, ornamental iron works, foundries, blast furnaces, carriage factories, car shops, blacksmithing and wheelwrighting, brick, tile and pottery manufactories, marble and stone works, manufactories of paints, chemicals, ice, electric light plants, carpenter work, canning factories, creameries, and numerous others.

Railroads.— The principal railway lines are the Central of Georgia, 1,302.23 miles; Southern, 919.90 miles; Seaboard Air Line, 648.49 miles; Atlantic Coast Line, 667.70 miles; Georgia Railroad, 302.50 miles. There are many other important railroads in the State whose combined mileage is 2,194.50. The total railroad mileage of the State is 6,035.32. Besides these are numerous electric lines in the cities of the State and their suburbs, connecting them in many instances with neighboring towns.

Finances.— In 1903 the assessed valuation of the State was $467,310,646 and the bonded debt $7,531,500 net. The tax rate was $5.30 per $1,000.

Banks.— There are 39 national banks, with a capital stock of $5,046,000, deposits of about $20,000,000, and reserve of about $9,000,000; 243 other banks with about $10,100,000 capital, and over $30,000,000 deposits.

Education.— In addition to her public school system Georgia has numerous private schools and several noted colleges for both sexes. In the public school system there are 7,700 schools, of which 4,919 are for whites and 2,781 for colored. The total number of teachers is 9,180 of whom 5,997 are white and 3,183 colored. The number of normal trained teachers is 2,238, of whom 1,791 are white and 447 colored. The number of pupils admitted during 1901 were 439,645, of whom there were 258,984 whites and 216,359 colored. The average daily attendance was 159,562 white and 105,826 colored, making a total of 265,388. Among the leading higher institutions of learning are: University of Georgia, Athens; and its branches as follows: North Georgia Agricultural College at Dahlonega, Georgia School of Technology at Atlanta, Georgia Normal and Industrial College (for ladies) in Milledgeville, Georgia State Normal School (for both sexes) at Athens, and the Georgia State Industrial College for Colored Youths, near Savannah; affiliated with the University of Georgia, but not receiving State funds: South Georgia Military and Agricultural College at Thomasville, Middle Georgia Military and Agricultural College at Milledgeville, West Georgia Agricultural and Mechanical College at Hamilton. Other noted colleges are: Emory College, Oxford; Mercer University, Macon; Wesleyan Female College, Macon; Shorter Female College, Rome; Agnes Scott Institute, Decatur; Lucy Cobb Institute, Athens; Southern Female College, College Park (near Atlanta); Southern Female College, La Grange; La Grange Female College, La Grange; Andrew Female College, Cuthbert; Monroe Female College, Forsyth; Young Female College, Thomasville; St. Stanislaus College, near Macon; Young L. Harris Institute, Young Harris; Brenau Female College, Gainesville; Piedmont Institute, Rockmart; South Georgia College, McRae. With the exception of the State Industrial College for colored youths, at College near Savannah, all the above-named institutions are for whites exclusively. For the colored people there are the following institutions: Atlanta University, Clark University, Spellman Seminary, Morris Brown College and Gammon University, all at Atlanta; Payne Institute at Augusta, under the auspices of the Methodist Episcopal Church, South.

The number of pupils enrolled in private schools and colleges is 10,097 whites and 4,877 colored, total 14,974.

Religion.— The Baptists have 368,000 members, 3,586 church buildings, and 76,000 Sunday-school pupils; the Methodists have 272,000 members, 3,205 church buildings, and 117,828 Sunday-school pupils; the Presbyterians have 18,000 members, 327 church buildings, and 12,600 Sunday-school pupils; the Congregationalists have 4,714 members, 65 church buildings, and 4,284 Sunday-school pupils; the Episcopalians have 7,976 members, 137 church buildings, and 4,400 Sunday-school pupils; the Disciples of Christ have 9,805 members, 110 church buildings, and 7,147 Sunday-school pupils; the Roman Catholics have 20,000 church members, 40 church buildings, and 2,500 Sunday-school pupils. The Hebrews in Georgia number about 6,200.

Charitable Institutions.— The principal benevolent institutions of Georgia are: the Orphan House at Bethesda, near Savannah, founded in 1739; the State Lunatic Asylum at Milledgeville; Georgia Institute for the Deaf and Dumb, at Cave Spring; Academy for the Blind at Macon; Female Asylum at Savannah; Augusta Orphan Asylum at Augusta; Orphan Home of the North Georgia Conference of the Methodist Episcopal Church South, at Decatur; Orphan Home of the South Georgia Conference of the Methodist Episcopal Church South, at Macon; Mumford Industrial Home for boys and girls, near Macon; Appleton Orphan Home (Episcopal), Macon; Baptist Orphans' Home, Hapeville, near Atlanta; Hebrew Orphan Home, Atlanta; Abram's Home for widows in Savannah.

State Government.— The State Constitution adopted in 1877 carefully guards the rights of the people and prevents extravagant appropriations by the legislature. The governor is elected for two years and receives a salary of $3,000. The state-house officers are: the attorney-general, comptroller-general, adjutant-general, treasurer, secretary of state, state school commissioner, commissioner of agriculture, state geologist, state librarian, commissioner of pensions, three prison commissioners, and three railroad commissioners. The supreme court consists of one chief justice and five associate justices. There are 24 superior court circuits, each having a judge and solicitor. Georgia is represented in the National Congress by two senators and 11 representatives.

Population and Division.— The population of Georgia at each census is as follows: (1790) 82,548; (1800) 162,686; (1810) 252,433; (1820) 340,985; (1830) 576,823; (1840) 691,392; (1850) 906,185; (1860) 1,057,286; (1870) 1,184,109; (1880) 1,542,180; (1890) 1,837,353; (1900) 2,216,331. The total white population in 1900 was 1,181,109 and the total colored 1,034,998. There were also 204 Chinese, 1 Japanese, and 19 Indians. The foreign-born population numbered 7,603 males and 4,800 females. There are 137 counties in the State.

Of 372 incorporated places in Georgia 40

had a population in 1900 of more than 2,000 and 13 of these had a population in excess of 5,000. Atlanta, the capital, had 89,872; Savannah, the chief seaport, had 54,244; Augusta, the greatest cotton manufacturing city of the South, had 39,441; Macon had 23,272; Columbus, the second great cotton manufacturing city of the South, had 17,614. Other cities of the State having over 5,000 inhabitants in 1900 are: Athens, 10,245; Brunswick, 9,081; Americus, 7,674; Rome, 7,291; Griffin, 6,857; Waycross, 5,919; Valdosta, 5,613; Thomasville, 5,322.

History.— A charter for the establishment of the colony of Georgia was obtained from George II., king of England, in June 1732, by a number of benevolent gentlemen of London, whose design was to found a home for the poor of Great Britain and a place of refuge for the Salzburgen and other persecuted sects of the continent of Europe. The colony was also intended as a military settlement to serve as a barrier against encroachments of the Spaniards upon South Carolina. Gen. James Edward Oglethorpe, a man of great liberality and of marked ability and experience in military affairs, being selected by the trustees as governor, brought over 116 emigrants. Landing at Yamacraw Bluff on 12 Feb. 1733, they laid the foundations of the city of Savannah and colony of Georgia. At first rum and slavery were prohibited, but in 1747 these restrictions were removed. During the 10 years of Oglethorpe's administration many settlers of a very desirable kind were brought into the colony, peace with the Indians was secured by treaties, their lands being in every instance procured by purchase, a formidable Spanish invasion was defeated, John and Charles Wesley and George Whitefield preached to the people and Whitefield founded the Orphan Home at Bethesda a few miles from Savannah. In 1752 the trustees of Georgia surrendered their rights to the crown and in 1754 John Reynolds was appointed governor. At the close of the French and Indian war the boundaries of Georgia, which had embraced a territory between the Savannah and the Altamaha rivers, were extended to the Mississippi on the west, and to latitude 31° and the St. Mary's River on the south. Subsequently they were extended on the south to latitude 30° 21′ 39″. Georgia united with the other colonies in resisting the aggressions of the mother country. On 11 May 1775 Col. Joseph Habersham and Commodore Bowen with 30 volunteers seized the powder magazine at Savannah and secured 13,000 pounds of powder, of which the Georgia authorities sent 5,000 pounds to the Continental army at Boston. In March 1776 the Georgians under Col. McIntosh aided by the Carolinians under Col. Bull burned 3 and disabled 6 out of 11 merchant vessels which under the protection of some British war vessels were endeavoring to carry on trade with some loyalist planters. In April 1776 Georgia instructed her delegates in Congress to vote for independence. The signers of the declaration on the part of Georgia were Button Gwinnett, Lyman Hall, and George Walton. In December 1778 the British captured Savannah and early in 1779 Augusta. But the Carolinians under Andrew Pickens and the Georgians under John Dooly and Elijah Clarke by the victory of Kettle Creek recovered Augusta. Subsequently the British defeated Ashe at Brier Creek and repulsed the combined attack of the Americans under Lincoln and the French under D'Estaing at Savannah. This battle at Savannah was one of the most important conflicts of the Revolution. After the fall of Charleston, S. C., in 1780, the British overran all eastern Georgia. But Col. Elijah Clarke made a desperate effort to retake Augusta. Failing he tried again in 1781 and, by the assistance of Pickens and "Light Horse" Harry Lee, succeeded. Almost the last fight of the Revolution was Wayne's victory over the Indian allies of the British near Savannah, 23 June 1782. On 11 July 1782 Savannah was evacuated by the British and the authority of Georgia was established over all her borders. On 2 Jan. 1788 a convention of delegates from the different counties of the State at Augusta ratified the Constitution of the United States on behalf of Georgia.

In 1802 Georgia ceded to the Federal government all her lands west of the Chattahoochee embracing the greater part of the present States of Alabama and Mississippi. In 1807 Milledgeville became the capital. During the second war with Great Britain 1812–15 the Georgians under Gen. John Floyd gained several battles over the Indians and shared with the Tennesseeans in the decisive victories won over the savages by Gen. Andrew Jackson. In the Mexican war Georgia's sons were distinguished, among whom Col. James S. McIntosh was killed at Molino del Rey and W. H. T. Walker was desperately wounded at Chapultepec.

Georgia seceded from the Union 19 Jan. 1861 and furnished to the Confederate army 94 regiments and 36 battalions, embracing every arm of the service. On Georgia soil were fought the battles of Chickamauga, Ringgold, Resaca, New Hope Church, Kennesaw Mountain, Peach Tree Creek, Atlanta, Jonesboro, Allatoona, and numerous smaller engagements and skirmishes. At the close of the Civil War Georgia resumed her career of enterprise in every industrial line, not waiting even for her re-entrance into the Union, which occurred in 1870. During the Spanish-American war Georgia furnished more volunteers in proportion to population than any other State.

Among prominent Georgia citizens have been Gen. Joseph Wheeler, William H. Crawford, John McPherson Berrien, George M. Troup, George R. Gilmer, Herschel V. Johnson, Howell Cobb, Robert Toombs, Alexander H. Stephens, Joseph E. Brown, John B. Gordon, Alfred H. Colquitt, Benjamin H. Hill, Sidney Lanier, the poet; Dr. J. Crawford Long, the discoverer of anæsthesia; Bishop George F. Pierce, Allen D. Candler.

Joseph T. Derry,
Editor of 'Georgia, Historical and Industrial.'

Georgia, South, an island in the South Atlantic, lat. at its north point, 53° 57′ S.; lon. 38° 13′ W. It is 90 miles long, and has high and rocky coasts, inaccessible from ice during a greater part of the year.

Georgia, Strait of, a large inlet of the North Pacific Ocean, between the continent of North America and Vancouver's Island; about 120 miles in length from north to south; the breadth varies greatly in its different parts, from 6 miles to 20. It communicates with the ocean on the north by Queen Charlotte's Sound, and on the south by the Strait of Juan de Fuca.

Georgia, University of, an important university which is at the head of State education in Georgia. It was chartered in 1785 and is the oldest State university. The charter coordinates primary and secondary schools with the university in the scheme of education by the State. The institution was located at Athens, and began academic work in 1801. This is the parent institution and includes four colleges; (1) Franklin College, the college of the liberal arts; (2) State College of Agriculture and the Mechanic Arts, on the Morrill foundation. (3) Law School. (4) Graduate School. The phrase «University of Georgia» in the wider sense includes the various colleges in different parts of the State which are declared by law to be «parts» of the university. These are: North Georgia Agricultural and Mechanical College, at Dahlonega; Medical College, at Augusta; School of Technology, at Atlanta; Georgia Normal and Industrial College, for women, at Milledgeville; State Normal School, for men and women, at Athens; Industrial College, for negroes, at Savannah. The university, in the collective sense, has (1903) 1,884 students of college grade; 156 in professional schools; 585 in preparatory schools; total, 2,527. The members of the faculties number 160. All these institutions are managed for the most part by local boards or commissions, but legal title and control of all of them is vested in the single Board of Trustees of the university. This is a unique feature of organization of the higher education of the State and differentiates it from the system of any other State. Understood in the narrower sense, the single institution at Athens has 359 students, and its income is $50,000 per annum. Among the alumni of national reputation are Howell Cobb, speaker of the House of Representatives and secretary of the treasury; Alexander H. Stephens, John A. Campbell, justice of the United States Supreme Court; senators Robert Toombs, Benjamin H. Hill, Augustus O. Bacon; Joseph and John LeConte, afterward president and professer in the University of California; Henry Timrod, poet; Henry W. Grady and J. L. M. Curry, diplomat and educator. As the university is a State institution, tuition is free for residents of Georgia in all schools except the professional schools; non-residents pay a small fee.

Georgia Bark, a small tree of the Southern States closely resembling the cinchona or Peruvian bark, and belonging to the natural order *Cinchonaceæ*. It has pretty large white flowers, with longitudinal stripes of rose-color, disposed in beautiful clusters at the extremities of the branches; each flower is accompanied with a floral leaf, bordered with rose-color near the upper margin; the corolla is tubular; the stamens five, with a single style; and the capsule contains two cells and numerous seeds. The wood is soft and is therefore unfit to be used in the arts. The inner bark is extremely bitter, and is employed with success in intermittent fevers.

Georgian Architecture, a neo-classic style of architecture that flourished in England from about 1715 to 1800, during the reigns of the four Georges, from whom it derives its name. It was a union of the Italian and Palladian styles divested of excessive ornamentation, and is to be found throughout the United States in buildings of the Colonial period. Among its prominent exponents were Gibbs, Campbell, Chambers, and Dance; Somerset House, and the church of St. Martin's-in-the-Fields, London, are fine types of the style.

Georgian Bay, Canada, formerly LAKE MANITOULIN, the northeastern part of Lake Huron, partly separated from the main body of the lake by the peninsula of Cabot's Head and the island of Great Manitoulin, province of Ontario. It is about 120 miles long and 50 broad.

Georgian, or **Ibernian,** or **Grusinian.** The people (about 600,000) who speak the Georgian language call themselves Karthveli, but are also named Grusini, and inhabit the valley of the upper and middle Kur, those of the Rion and Tchoruk, as far as the promontories of the Ararat chain, and north to the Alazan, beyond which their language is mixed with the tongues of Shirvan and Daghestan, as far as the Caspian Sea. Probably descendants of the Colchi and Albani, they were anciently called Iberi, and, according to tradition, are akin to the Armenians, although their language differs from the Haikanian (*Somasi* in Georgian), and is believed by their learned prince Theimuraz to be primitive. Brosset and Voss (1847) place it among the Indo-European languages. It consists of several dialects, namely: The Karthveli or Georgian proper in the centre, the Kakheti and Imerethi next, then the Mingreli and Guri, and more remotely the Suani and the Lazi, which reaches almost to Trebizond. A colony transported into Asterabad in Persia in 1622 is said to speak a purer idiom than any of those now spoken in Georgia. Georgian literature is mostly founded on that of Greece. The Bible was partly translated in the 8th century, finished in the 18th, and splendidly printed at Moscow, Tiflis, and St. Petersburg. Arabic and European works have also been translated into Georgian. We can mention but a few of the many remarkable national works. Among the romances are the following: 'Tariel' (Of the Man in the Tiger Skin), by Skhotta of Rusthvel, a general of the heroic queen Thamar, with a commentary by King Wakhtang VI. (Tiflis 1793); 'Daredjamiani' (Deeds of Amiran, son of Daredjan, a hero of Bagdad), by the courtier Moses of Khoni; 'Visramiani' (Love of the Princess Vis for Prince Ramin), somewhat resembling Rousseau's 'Héloïse'; 'Miriani' (story of the Chinese Princess Miri), imitated from the Persian. These and many others exhibit lively imagination and good taste. The 'Thamariani' is a panegyrical epic on Queen Thamar, by Tchakhakhadze. In poetry, there are versions of lyrical poems from the Greek, etc., by Georgi Aphoni (11th century); a collection of historic odes; there is also a very keen satirical work by Bessarion Gabas Khoili. There are many histories of Georgia, chronicles, biographies, histories of families, monasteries, etc. The drama began to be cultivated at a late period, especially by Prince Eristov. Wakhtang VI. established a printing office at Tiflis. There are also there at present a national theatre and opera house. The 'Aurora,' a periodical established in 1857, and the 'Kavkas,' a Russian newspaper, are published at Tiflis.

Geotropism, jē-ŏt'rō-pĭzm, the influence which causes a tendency in plants and animals to grow toward the centre of the earth; it is defined by Dr. John Coulter as "sensitiveness to gravity." Geotropism in its simplest form, called "positive," causes growth directly downward, as in the tips of roots, which strike straight down into the earth. So strong is this influence upon roots that they will turn from any abnormal position in which they are placed and bend downward until they reach and penetrate the ground,— an adaptation for the preservation of plants against dislodgment by wind or water. The reverse of this is negative geotropism (apogeotropism), the influence which causes parts of plants, particularly stems, to grow *away from* the earth. A demonstration of these opposing influences in regulating plant-growth is found in the fact that when seedlings are caused to revolve continuously and rapidly for a period, their stems point and increase toward the centre of the centrifugal force, while the roots take the opposite line of growth. A third form of the tendency is called "diageotropism," and leads parts subject to its influence, as runners and rhizomes, to grow horizontally; that is, in a direction at right angles to the plane of positive geotropism. This influence is seen in the tendency of branches and foliage to assume a horizontal position. In all these cases, however, the result is modified and complicated by influences of sunlight, moisture, etc., styled heliotropism, hydrotropism, chemotropism, etc. (qq.v.); and sometimes, as in the case of twining plants, it is impossible at present to extricate them and assign to each its part in the result.

Geotropism, or the influence of gravity, has had a great effect, also, upon the forms of animals, especially in determining proportions and strength of parts with reference to weight. Associated with other influences it determines the "instinct" which leads many of the lower forms of life to seek the earth whenever possible, or at the proper time, a striking example of which is found in those caterpillars which, born in tree-tops, migrate to the ground as soon as born or when ready to begin their metamorphoses.

Gephyrea, jĕf-ĭ-rē'a, worms allied to the chætopod annelids, but differing from them in not being segmented, though provided with bristles. The mouth is either surrounded with a circle of tentacles, or is overhung by a large broad "proboscis," which in the European *Bonellia* may be several times as long as the body and forked at the end. The vent is either terminal or situated dorsally on the anterior end of the body. They possess a true blood system similar to that of annelid worms. The young free-swimming larvæ of certain forms (*Echiurus*) are like the Trochophores (see Larva) of ordinary annelids. The male of *Bonellia* differs remarkably in shape and size from the female, being only 1 millimetre in length, while the female measures 3 inches, with a proboscis from 8 to 12 inches in length. Our most common form is *Phascolosoma*, which is cylindrical, its mouth surrounded with tentacles, the vent opens near the head, it is without bristles, and lives in dead shells, building out the aperture by a conical tube of sand. Its larva is cylindrical, the head small, with a circle of cilia.

Gepidæ, jĕp'ĭ-dē, a people of Gothic origin who settled about the mouth of the Vistula in the 3d century. Before the 5th century they had migrated to the Lower Danube, where they were subjugated by the Huns; but, revolting against Attila's son, they recovered their freedom and established themselves in Dacia. There their power grew so great that they levied tribute from the Byzantine emperors down to Justinian's days. In the end of the 5th century a powerful enemy arose to them in the Ostrogoths; and after them came the Longobards, who, in alliance with the Avars, inflicted a crushing defeat on the Gepidæ in 566. A part of the last named then submitted to the Avars, while a part accompanied the Longobards to Italy. Henceforward they passed out of history.

Gera, gā'rä, Germany, a town in the principality of Reuss-Schleiz, on the right bank of the White Elster, 35 miles from Leipsic. Among the chief buildings are the castle, the old Trinity Church, the town-hall, gymnasia, theatres, library, museum, town-hospital, etc. There are municipal water-works, electric tramways, scientific and artistic societies, etc. Pop. (1901) 45,640.

Gerace, jā-rä'chā, Italy, city in Calabria, on the east slope of the Calabrian Mountains and the shores of the Ionian Sea, 34 miles northeast of Reggio, and 64 miles by rail. It is on the site of the celebrated Greek Colony of Locri Epizephyrii. The cathedral, rebuilt in 1783, is partly of ancient materials. The district produces grapes, oranges, olives, and grain; and coal, iron, and marble are worked in the neighboring mountains. Pop. (1901) 10,595.

Gerah, gē'rä, the smallest piece of Hebrew money, being the 20th part of a shekel, or about 3 cents. Also, in Hebrew weights, a weight corresponding to the coin.

Geraldini, jā-ral-dē'nē, **Allesandro,** the first Roman Catholic Bishop of Santo Domingo: b. in Italy, 1455; d. in Santo Domingo, 1525. He was a soldier, and served in the army of Spain against Portugal, 1475-6, before taking orders. His learning and his friendship with Archbishop Mendoza, of Toledo, procured for him the tutorship of the royal princesses of Castile. He had great influence in the Spanish Court, and is said to have first interested Ferdinand and Isabella in behalf of Columbus. In 1520 he was made Bishop of Santo Domingo, after having held many high places in church and State. His residence and labors in the island, where he spent the remainder of his life, went far toward bringing law and order out of the chaos that followed upon the rule of the Spanish conquerors. His narrative of his journey thither and his description of Santo Domingo, printed in Latin (1631), is of great value and interest. He also wrote a life of Catharine of Aragon in verse.

Gerando, Joseph Marie, zhō-zĕf mä-rē zhā-rōn-dō, Baron de, French author: b. Lyons, France, 29 Feb. 1772; d. Paris, 11 Nov. 1842. He became governor of Catalonia in 1812, and was professor of public law in the law faculty of the University of Paris from 1828 to 1842. His works, treating law, philosophy, and other subjects, include: 'Des signes et

de l'art de penser' (1800); 'Histoire comparée des systèmes de philosophie' (1803); 'Institutes de droit administratif' (1829); and 'Cours normal des institutions judiciaries' (1839).

Geraniaceæ, jē-rā-nĭ-ā'se-ē, the geranium family, consisting of herbaceous plants or shrubs with opposite or alternate leaves, and white, red, yellow, or purple flowers with five sepals and five petals. Sixteen genera and about 750 species are known. They are found in temperate or hot climates, rarely in the arctic regions. They are often astringent and aromatic, abounding in vegetable oil.

Geran'ium, the typical genus of the *Geraniaceæ* (q.v.), having palmately lobed leaves, regular flowers and a five-lobed ovary, terminated by a long thick beak and five stigmas. On coming to maturity the carpels separate from the base and become resolute or spiral. The spotted crane's-bill (*G. maculatum*) is a very familiar species in the eastern and northern States. The root is astringent and has been used medicinally. The tubers of *G. parviflorum* are eaten in Van Diemen's Land, where it is called the native carrot. Indian geranium is the name given by perfumers to a species of *Andropogon*. The so-called geraniums of gardens are mostly species of *Pelargonium*, and are natives of southern Africa. See CRANE'S-BILL; PELARGONIUM.

Gerard, jē-rärd', **Dorothea.** See LONGARD DE LONGGARDE.

Gerard, Emily. See LASZOWSKI-GERARD.

Gérard, Etienne Maurice, ā-tē-ĕn mō-rēs zhā-rär, French marshal: b. Damvillers, Meuse, France, 4 April 1773; d. Paris 17 April 1852. For his brilliant services at Austerlitz (1805) he was appointed general of brigade; he also took a notable part at Jena (1806), Erfurt (1806), and Wagram (1809). During the Russian campaign of 1812 he rendered conspicuous service at the capture of Smolensk in the battle of Valontina-Gora, and at the passage of the Beresina. In 1831 he commanded the French army sent to the assistance of the Belgians against the Dutch, whom he drove out of Flanders, and 27 Dec. 1832 compelled the citadel of Antwerp to capitulate. After the July revolution of 1830 he was appointed marshal and war minister by Louis Philippe; he was again war minister from July to October in 1834.

Gérard, François Pascal, frän-swä päs-kāl, a French portrait and historical painter: b. of French parentage, Rome, Italy, 11 March 1770; d. Paris 11 Jan. 1837. At 10 he was brought to France, and at 16 became the pupil of David. In 1795 he exhibited 'Belisarius,' which first brought him into notice; shortly afterward he painted 'Psyche receiving the First Kiss from Cupid.' His portrait of Madame Bonaparte in 1799 was the beginning of his career as the "painter of kings." Almost all the royal and other celebrities who visited Paris between 1799 and 1837 were painted by Gérard, who owed his success not alone to his skill as a portraitist, but also to the charm of his manners and conversation. His most celebrated portraits are those of Napoleon in his coronation robes, the Queen of Naples and her children, Talleyrand, Talma, Louis Philippe, and Madame Recamier. The grandest of his works are, however, historical pictures, the 'Battle of Austerlitz' (1810) and the 'Entry of Henry IV. into Paris' (1814). Gérard was appointed first court painter and made baron by Louis XVIII.

Gerard de Nerval, zhā'raar'de-ñar'vaal, the pen-name of GERARD LABRUNIE, a French author: b. Paris 21 May 1808; d. there 25 Jan. 1855. His first book to attract attention was a volume of poems, 'Élégies Nationales.' In 1828 he produced his translation of Goethe's 'Faust,' which brought him the author's personal approval, and which Berlioz (q.v.) used largely as the score for his 'La damnation de Faust.' Gerard also wrote several original plays; was a regular contributor to various periodicals; and published 'Les illumines' and 'Contes et facéties' (1852), and 'Scenes de la vie orientale' (1848–50). While insane he committed suicide. His writings were collected in five volumes in 1868.

Gerard Thom (and variously also TUNC, TUM, or TENQUE), Italian monk, founder of the order of the knights hospitallers of St. John of Jerusalem: b. Amalfi about 1040; d. 1120. In the latter part of the 11th century he first visited Jerusalem, and while there was appointed the superior of a hospice for the convenience of pilgrims, and there he organized the religious order afterward so celebrated, duly recognized by a bull of Pascal II. in 1113.

Gerber, gār'ber, **Ernst Ludwig**, a German musical authority: b. Sondershausen, Germany, 29 Sept. 1746; d. there 30 June 1819. He published 'Historische-biographisches Lexicon der Tonkunstler,' a work which, commenced in 1790, was not completed until 1814.

Gerbers. See GUEBERS.

Gerbert. See SILVESTER II.

Gerda, jĕr'dä, (1) In Scandinavian mythology, wife of Freyr, and daughter of the giant Gymer; she is so beautiful that the brightness of her naked arms illuminates both air and sea. (2) In astronomy, an asteriod, the 122d found; discovered by Peters, 31 July 1872.

Gerez, hā-rēs, **Serra de**, Portugal, a mountain chain which ramifies from the mountains of Asturias and stretches between the basins of the Douro and Minho, from north to south, for about 18 miles. It consists generally of a succession of granite peaks, the loftiest of which, Murro de Burageiro, has a height of 4,296 feet.

Gerfalcon, or **Gyrfalcon.** See JERFALCON.

Gerhard, William Paul, American sanitary engineer: b. Hamburg, Germany, 30 July 1854. He was educated in Germany and came to the United States in 1877. He was chief assistant engineer to Col. George E. Waring (q.v.) at Newport, R. I., 1881–3, and has since practised his profession in New York. He is the author of 'House Drainage and Sanitary Plumbing' (1881, 7th ed. 1897); 'Sanitary House Inspection' (1885); 'The Prevention of Fire' (1886); 'Recent Practices in Sanitary Drainage of Buildings' (1890); 'Disposal of Household Waste' (1890); 'Gas Lighting and Gas Fitting' (1894); 'Theatre Fires and Panics: their Causes and Prevention' (1896); 'Sanitary Engineering' (1898); etc.

Gerhardt, Karl, American sculptor: b. Boston, Mass., 7 Jan. 1853. He studied in Paris

only. The Lord's Supper is an evening meal (as originally), preceded by mutual foot-washing (each sex separate), and followed by the right-hand of fellowship and the kiss of peace, and then by communion. Their organization is episcopal, the bishops or elders being elected by the members out of the higher of two grades of ministers, who with the deacons are also elected by the congregations. The latter with the State districts elect delegates (of either sex) to an annual conference, which is the binding legislative and executive authority on a two thirds vote.

The sect had the curious and unique fortune in the early eighties of having one party secede from it, as too progressive, and the other as not progressive enough. The Old Order Brethren objected to its humanitarian, missionary, and Sunday-school activities; the Progressive Brethren to the rules of dress and other conservative decisions of the conference. The Old Order, numbering in 1902 80 congregations, 140 ministers, and about 4,000 members, publish a newspaper, the 'Vindicator,' to oppose education, missions, Sunday-schools, and revivals. The Progressives had 145 congregations, 231 ministers, and 13,000 members, and are increasing at the expense of the "Conservatives," or mother body. They support a college and publishing house at Ashland, Ohio, and issue an organ, the 'Evangelist.' A small body of seventh-day German Baptists, with five churches and some 200 members, is usually included among the Brethren, and its tenets often absurdly accredited to them; but it is a separate church, long since parted from the others.

German Catholics, a religious sect which sprang up in Germany about the close of 1844, which rapidly increased during the four or five following years and then as rapidly declined. The immediate cause of the formation of this sect was the exhibition by Arnoldi, bishop of Trèves, of the holy coat preserved in the cathedral of that city and said to be the coat of Christ. The bishop accompanied the exhibition of the holy coat by a promise of plenary indulgence to whoever should make a pilgrimage to Trèves to honor it. The announcement of this proceeding on the part of the Bishop of Trèves produced a feeling of general astonishment in Germany and drew from a Silesian priest called J. Ronge, who had already been suspended from his charge on account of his independent views, a letter protesting against the exhibition of the holy coat and denouncing the projected pilgrimage as idolatry. This letter was published in the 'Sächsische Vaterlandsblätter' on 16 Oct. 1844, and produced an amount of excitement that was quite unanticipated by the writer. Ronge was excommunicated, but this only increased the general enthusiasm in his favor and when he entered into relations with Czerski, another independent priest who had seceded from the Church, and made along with him an appeal to the lower grades of the clergy to unite in founding a National German Church independent of the Pope and governed by councils and synods, the appeal received a ready answer from a considerable number of those to whom it was addressed. A number of congregations belonging to the new body were formed in the more important towns, especially in Leipsic, under the celebrated Robert Blum, and in Magdeburg under the teacher Kote. In the spring of 1845 there were already about 100. At this time (March 1845) a council was summoned to meet in Leipsic to deliberate on the affairs of the body. Only 20 congregations were represented there, but these nevertheless at once proceeded under the presidency of Prof. Wigard to arrange a system of doctrine and practice which was to form the basis of union for the whole Church. The Bible was recognized as the sole standard of faith, and its interpretation was left to reason, "penetrated and animated" by the Christian idea. Only two sacraments were admitted, baptism and the Lord's Supper. In matters of ritual each congregation was left free to carry into practice its own views. The organization of the new Church was almost the same as that of the Presbyterian dissenting churches of Scotland. Each congregation was to choose its own pastor and elders. Affairs of a general interest were intrusted to the management of a general council to meet every five years, but the decisions of this council were to be ratified by a majority of the congregations before they became valid. The confession of sins, the hierarchy of the clergy, and the celibacy of the priests were abolished and the authority of the Pope was not recognized. On the subject of purgatory nothing was declared either for or against it. The constitution of the new Church was thus a Protestant one, but in some respects the German Catholics went even further than the majority of Protestants in a liberal direction, inasmuch as they claimed for all, complete religious liberty and declared their religion to be capable of development and modification with the progress of the human mind.

The Church established on this basis had at first, as has already been stated, great success. The most eminent men of the liberal party regarded the movement with sympathy, or at least with interest. Gervinus expressed his belief that great benefits might result from it. Many Protestants, dissatisfied with the subjection of their religion to state supervision, joined the body, which, at the end of 1845, counted 298 congregations. But it was not long before the spirit of opposition began to show itself. The majority of the governments in Germany at the instigation both of the Protestant and the Roman Catholic clergy began to use repressive measures against the new body. Prussia contented itself with regulating the exercise of their worship; but some of the other states went farther. At Baden the adherents of the sect were deprived of their political rights. Austria took the course of banishing them from her dominions. But persecution from without did less hurt than the divisions within the body. Almost immediately after the meeting of the council at Leipsic a congregation had been formed at Berlin which refused to abide by its decisions. Czerski and Ronge, the two originators of the sect, became the leaders of two opposing parties within it, one of which, that headed by Czerski, clung to the traditions and doctrines of the Roman Catholic Church, rejecting only the supremacy of the Pope and the union between Church and State; while the other sought for more freedom, converted religion into a sort of popular philosophy and began to mix up with it questions of politics, exhibiting strong democratic tendencies. These were most plainly manifested during the revolutionary epoch of 1848. The schism be-

tween the two parties was then complete. One section of the congregations of German Catholics professed to have only religious ends in view, while another section openly pronounced itself in favor of socialistic principles.

From the year 1850, however, there were several attempts to re-establish the unity of the body. An effort was made to reintroduce harmony by widening the basis of union. Instead of founding a religion, a council held at Gotha in June 1859, proposed the formation of a religious association or confederation into which all free Protestant and even Jewish congregations were to be admitted. Legislation in the different states had become more tolerant and the carrying out of the scheme of the council of Gotha seemed to be at least practicable. But the result proved otherwise. The association consisted of too heterogeneous elements. While some of the members receding further and further from orthodoxy proclaimed simple deism as their religion and abolished baptism and the Lord's Supper, others on the contrary lost themselves in an exaggerated mysticism. According to the most recent statistics there are still about 100 congregations of German Catholics in Germany; but their numbers only amounted to about 6,200 in 1895.

German East Africa, the largest German colonial possession, extending from lat. 1° to about 11° 41′ S., and from lon. 29° to 40° 40′ E. It has a coast line of 620 miles, and lies between British East Africa, Indian Ocean, Portuguese East Africa, Rhodesia, Congo Free State, and the British Sudan. The area is 384,000 square miles. The German empire is represented by an imperial governor, who appoints a council of five in each of nine communes. There is a military force of 232 Germans and 2,000 natives. The region produces almost every kind of tropical fruit, fibres, sugar, tea, etc. In 1901 over 1,600 tons of copra were exported. The chief seaports are: Dar-es-Salaam (pop. 13,000); Bagamoyo (pop. 14,000); Saadani, Pangani, Kilwa (pop. 10,000 each), and several smaller towns. A railroad from Tauga is open for traffic to Muhesa and Korogme, 54 miles. There are nine telegraph stations in the coast towns. The trade is chiefly with Zanzibar and Germany. Pop. (1901) 6,750,000 natives, 15,347 foreigners, mostly Arabs, Syrians, and Loanese.

German Empire. See GERMANY.

German Evangelical Protestant Church, in the United States, a religious body, liberal in doctrinal belief, having no confession of faith. Its ministers are associated in district unions. There are 52 churches having a membership of 36,156.

German Evangelical Synod of North America, a religious body, accepting the symbolical books of the Lutheran and Reformed churches, representing in the United States the State Church of Prussia, which is a union of the Lutheran and Reformed bodies. It celebrated, 12 Oct. 1890, the semi-centennial anniversary of its organization in the United States. In 1900 there were 909 ministers, 1,129 churches, and 203,574 members.

German Ivy, (*Gynosys cordifolia* or *Senecio scandens*), a creeping plant of the *Compositæ* family, with fleshy light-green leaves. It is commonly grown as a house plant.

German Language and Literature. The German language, called by the Germans *Deutsch* or *Die deutsche Sprache*, is one of a group or family of allied tongues known by the name of Teutonic or Germanic, and including English (Anglo-Saxon), Dutch, Danish, Icelandic, Swedish, and Gothic; to which may be added, as of less importance, and having more the character of dialects, Norwegian, Frisian, Plattdeutsch (the vernacular of the North German lowlands), and Flemish, which differs little from Dutch. It is also distinguished as High German, being originally the language of the more inland and elevated parts of Germany. Three chief periods are usually distinguished in the history of the language — those of the Old, the Middle, and the New High German — the last being the ordinary literary German of the present time. Old German is known by monuments of the 7th century, when it was split up into three divisions: Upper German among the Alemanni, Bavarians, and Longobards; Low German among the Frisians, Saxons, and Westphalians; and a middle group in Hesse, Thuringia, and Franconia. The eastern part of Germany was at that time occupied by Slavic tribes. The Franconian dialect prevailed during the reign of Charlemagne and for some time after; the Longobardic early fell into disuse.

Middle High German became literary in the 12th century, its poetry giving it a predominance over a wide area. It was surpassed during the following year by the Suabian, which had a still wider field. Other idioms attempted to rival these two, but in all the writings of the 14th and 15th centuries the Suabian influence is apparent. The Low German 'Sachsenspiegel,' and other law books, were translated into Upper Saxon, which at last became the language of literature and cultivated society in Germany, in consequence of the translation of the Bible by Luther. Luther's translation may be said to have settled the High German as a literary language upon a fixed and permanent basis. The language was afterward much corrupted by admixtures from foreign languages, especially during the Thirty Years' war, which deluged Germany with hosts of mercenaries from all parts of Europe; but the great writers of the 18th and 19th centuries — poets, historians, philosophers, critics, etc.— have brought it to its present eminence. Although wanting the precision and clearness of the French, the soft music of the Italian, and the flexibility and grammatical simplicity of the English, yet it has acquired a majesty, energy, and charm of its own, and the German translators of Homer, Dante, and Shakespeare have reproduced the thoughts of the original with a force and fidelity unrivaled in any other language.

Literature in Germany received its first impulse from the fondness of the Germanic races for celebrating the deeds of their gods and heroes. Of these early songs in praise of the gods Tuisco and Mann, and of the hero Arminius, who conquered the Romans in the great battle in the Teutoburger Forest, nothing even in a translated form has been handed down to us. The legends immediately connected with the Gothic, Frankish, and Burgundian warriors of the period of national migration — the 'Dietrich' (Theodoric) and 'Siegfried-Sagen,' the 'Hildebrandslied,' etc.— have for the most part some historical foundation, and many of them

were eventually incorporated in the 'Nibelungenlied,' the most celebrated production of German mediæval poetry. On the introduction of Christianity literary activity really began. The British missionaries established cloisters and brotherhoods in Germany between the 6th and 8th centuries, and laid the foundation for that system of education, which was most fully developed under the fostering care of Charlemagne. Metrical translations of the Evangelists appeared in the 9th century in the High and Low German dialects; the 'Krist' of the High German in rhyme, the 'Heliand' in the other idiom, preserving the ancient alliterative form of verse. One of the best specimens of Old High German literature is a translation of the Psalms by Notker about the same period. The 'Ludwigslied,' a pæan in honor of the victory of Louis III., king of the Franks, over the Normans in 883, which Herder extols as one of the best specimens of early German poetry, was composed in Old High German by a Frankish ecclesiastic. The preservation of the 'Hildebrandslied' is also due to churchmen, who transmitted it partly in the high and partly in the low forms of the dialect. Several Latin hymns, too, were based on Hunnish and Burgundian legends and the 'Thiersagen,' beast-fables; but with these exceptions the clergy were generally opposed to the national poetry, on account of its pagan associations.

In the 12th and 13th centuries poetry passed from the monasteries and ecclesiastical schools to the palaces of princes and the castles of nobles. The deeds and tales of the Crusaders, the fresh bloom of chivalry, the lays of the troubadours and the trouvères of Provence and Normandy, had a powerful influence on the spirit, form, and language of German poetry. Many of the poets of this period were nobles by birth, some of them even princes. Heinrich von Veldeke was the first to introduce into his heroic poem 'Eneit' (composed, it is said, after a French translation of Virgil) that spirit of devotion to women called by the old Germans *Minne* ("Love," hence the name *Minnesänger*, "Love-Minstrel"). Veldeke is considered the originator of the heroic minstrel songs, but he is far surpassed by Wolfram von Eschenbach, the author of 'Parzival,' and the unfinished epics 'Titurel' and 'Wilhelm von Oranse.' In the first-mentioned poem are embodied the legends of King Arthur, the Knights of the Round Table, and the San Graal (Holy Grail). These traditions, together with the exploits of Charlemagne, of Alexander the Great, and the Trojan heroes, inspired also the lays of Gottfried of Strasburg, Herbort von Fritzlar, Hartman von der Aue, and Konrad of Würzburg. The love songs of this period breathe a purer and more reverential devotion to woman than the songs of the French troubadours. A species of lay, called *Wachtlied*, "watch-song," peculiar to this time, consists of a dialogue between a lover and the sentinel who guards his mistress. The inventor, or at least the most gifted author in this department of lyric poetry, is Walter von der Vogelweide, the victor in the poetic war of the Wartburg. Next to him rank Heinrich von Ofterdingen, Reimer der Alte, Heinrich von Morungen, Gottfried von Nerfen, and the Austrian bards Nithard and Tannhäuser. Several hundreds of these poets were engaged in traveling from palace to palace, and from castle to castle. Their songs were mostly in the Suabian dialect, and the poets constituted what is called the Suabian school, which may be said to have risen and fallen with the Suabian emperors of the house of Hohenstaufen (1138–1254). The crowning event of this era was the appearance of the 'Nibelungenlied' (about 1210), the greatest of the Old German epics. The origin of this poem is a subject of as much controversy as that of the 'Iliad' and 'Odyssey.' Some will have it that the poem is but a series of popular ballads strung clumsily together, without the slightest alteration, by some obscure personage; others will have it that the first part, Siegfried's Tod, was the production of one author, and the second part, Kriemhilden's Rache, that of another; while again a third authority asserts it to be the work of one hand. It was closely followed by a not unworthy successor, Gudrun, and by the 'Helden-Buch' (Book of Heroes), which consists of a collection of fragmentary pieces treating of the same legends as the Nibelungenlied, but mixed up with tales of the Crusaders. In the 13th century didactic poetry began to be cultivated with some success: the dawn of historical literature is heralded by several local chroniclers. Ulrich von Lichtenstein deplores, in his poem 'Frauendienst' (1275), the decline of chivalry, but his attempt to revive its spirit was hopeless. In the troublous times of the Interregnum (1256–73) the gay and gallant knights degenerated into little else than gloomy robber chiefs; and poetry passed from their abodes to the homes of the private citizen and the workshops of the shoemaker and weaver. These plebeian songsters formed themselves into guilds in the imperial cities — Nuremberg, Frankfort, Strasburg, Mainz, etc., and were called *Meistersänger*, in contradistinction to the knightly *Minnesänger*. In the 14th century Germany produced several mystical theologians, disciples of Meister Eckhart, the most celebrated of whom were Tauler and Suso, whose sermons and writings paved the way, in some measure, for the Reformation. The last echoes of the chivalric lays were two allegorical romances, 'Theuerdank' (in verse) and 'Weisskunig' (in prose), written in great part, if not wholly, by the Emperor Maximilian I., and transcribed and perhaps polished by his private secretary, Melchior Pfinzing. An important event of the 14th century was the foundation of the University of Prague (1348), soon after followed by similar establishments throughout the length and breadth of the empire. The only good poetry in the 14th, and up to the close of the 15th century, were the spirited lays of Halb Suter and Veit Weber, who celebrated the victories of Switzerland over Austria and Burgundy. Classical culture was greatly furthered by the establishment of Deventer University in 1400 by Gerhard Groot, and of many schools in imitation of it in Germany and the Low Countries. Among the students were Hegius, Reuchlin, and Agricola. Peurbach was the first restorer of mathematical science, and his pupil Regiomontanus (Johann Müller) was the greatest mathematician of the 15th century. The invention of printing caused a still increasing literary activity, and the works printed in Germany between 1470 and 1500 amounted to sev-

eral thousand editions. In 1498 there was published the celebrated beast-epic 'Reineke Vos' ("Reynard the Fox"), which, according to Jakob Grimm, originated with the Frankish tribes, who carried it with them when they crossed the Rhine and founded an empire in Gaul, and from whom it was diffused among the neighboring tribes of northern France and Flanders. The 16th century opens with the foundation of the University of Wittenberg (1502), and, along with the Reformation, inaugurates a new era in literature by Luther's translation of the Bible. The Misnian dialect as used by him is so pure, harmonious, and beautiful that all the other dialects, which had until then alternately predominated in German composition, were from this time gradually banished from literature, and the idiom of the Bible (now known as the Neu Hochdeutsch, New High German) has now become the sole medium of intercourse in cultivated society in the empire. Besides his translation of the Scriptures, Luther (1483–1546) enriched the national literature with many religious songs, many of which have become classical, and have found hosts of imitators, the most successful of whom were Decius and Speratus, and in the 17th century Gerhard. Michael Weiss translated the hymns of Huss into German. The writings of Luther, Zwingli (1484–1531), Sebastian Frank (1500–45), Melanchthon (1497–1560), Ulrich Von Hutten (1488–1523), a remarkable anonymous treatise, 'Das Büchlein von der Theologie,' edited by Luther himself, and other works by eminent reformers and scholars, constitute the principal theologic literature of the Reformation. History was now written in a superior style, and with greater comprehensiveness, by Frank in the 'Zeitbuch' and 'Weltbuch,' and by Sebastian Münster (1489–1552) in his 'Kosmographie'; also by Tschudi (1505–72) in 'Chronicles of Switzerland,' and by Aventinus (1477?–1534), the Bavarian chronicler. Seb. Frank published also a collection of German proverbs, which was, however, far inferior to that published under the title of 'Auslegung deutscher Sprüchwörter,' by his predecessor, Johann Agricola (1492–1566). The principal literary events in prose belles-lettres of this period is the appearance of a popular literature in the shape of 'Volksbücher' (People's-books), in which were reproduced, in short compass, many of the ancient traditions, legends, and tales of Germany and other lands. Boccaccio, Poggio, and other Italian novelists, were also introduced by translation to the notice of German readers. The Reformation period was particularly fruitful in satirical and allegorical works. One of the most remarkable of the former kind was the 'Narrenschiff' (Ship of Fools), by Sebastian Brandt or Brant (1458–1520), a metrical satire on the follies of the century, and which was imitated by Thomas Mürner (1476–1536) in his 'Narrenbeschwörung' (Conjuration of Fools). Mürner was one of Luther's bitterest opponents, and wrote a coarse yet clever satire on him, 'Von dem grossen Lutherischen Narren' (Of the great Lutheran Fool). The most talented and satirical didactic poet of the period was Johann Fischart (1545?–89), author of a romantic poem, 'Das glückhafte Schiff,' which is regarded as a model, and numerous other works, many of them written in the Rabelaisian style. The story of 'Faust,' of the 'Wandering Jew,' the 'Autobiography of Götz von Berlichingen' (afterward celebrated by Goethe), and the comical 'Till Eulenspiegel,' which relates the freaks and drolleries, fortunes and misfortunes, of a wandering mechanic, were among the most popular works of this age. At this time appeared Hans Sachs (1494–1576), the cobbler of Nuremberg, the Meister of the Meistersänger, as he is called by Herder, who excelled in all styles of composition, in tragedy, comedy, psalms, allegories, fables, tales of a religious and of a broadly comic character, etc. Frauenlob and Michael Behaim also wrote several notable poems; and Rosenblüt and Folz were tolerably successful playwrights, the former being also one of the best tale-writers of his time. The most successful rival of Sachs as a dramatist was his townsman, Jakob Ayrer (died 1605), who excelled him in the skilful arrangement of plot. Among the purely didactic fabulists were Burkard Waldis, Erasmus Alberus, and Georg Rollenhagen, the two former being also famous as composers of hymns. During the excitement occasioned by the Reformation almost all branches of literature were cultivated, but it was in learned and scientific treatises that the age was most prolific. Besides Melanchthon, whose influence secured the preponderance of the Aristotelian philosophy in the Protestant schools of Germany, there were Luther, Camerarius, Cornelius Agrippa, Paracelsus, Copernicus (astronomy), Leonhard Fuchs (botany and medicine), Conrad Gesner (zoology and classics), and Agricola (mineralogy). At the close of the 16th century few of the great scholars were left, and classic learning was beginning to decline in the early part of the 17th. The universities and schools which had sprung up under the influence of the Reformation were no longer animated with the zeal of the reformers, but engrossed by subtle polemical and scholastic strifes. The 17th century has been called, in German literature, the period of imitation. Most of the poets of this age were graduates of universities; and learned societies on the model of the Academia della Crusca were formed for the purpose of improving the language and literature. After their dissolution they were replaced by literary and scientific associations in Leipsic, Berlin, Hamburg, Halle, Königsberg, and in several other of those Protestant towns in north Germany which, greatly owing to the establishment of their universities, had become the chief centres of culture. A new school of poetry was founded, of which Martin Opitz (1597–1639) was the leader. His works are more remarkable for smoothness of versification and an occasional felicity of expression than for true poetic inspiration; but they exerted a healthy influence at a time when the Thirty Years' War and the growing taste for inferior French and Italian compositions threatened to annihilate all vestiges of pure German poetry, and when the reforms introduced by Luther into the language still required to be insisted upon. This first Silesian school, as it was called, after the birthplace of its chief, counted among its members many ingenious writers, as Simon Dach (1605–69), Von Zesen (1619–89), Johann Rist (1607–67), and, greatest of all, Paul Fleming (1609–40), whose lyrics are natural and cheerful as the songs of a lark. Equally great, but totally different in disposition, was the leader of the second Silesian school, Andreas

Gryphius (1616–64), who, besides being the author of many passionate yet melancholy poems, may be looked upon as the founder of the modern German drama. In poetry and in the drama Gryphius had several imitators, the principal being Lohenstein (1635–83), whose tragedies teem with slaughter and pompous phrases; Christian Weise (1642–1708), a comedian of infinite humor, though sometimes of a rough sort; and Hoffmann von Hoffmannswaldau (1618–89), Asman von Abschatz, Christian Gryphius, and others. Both the Silesian schools were opposed first by the "court poets," Canitz (1654–99), Neukirch (1655–1729), Günther (1695–1723), and others; and, secondly, by the Hamburg school, best represented by Brockes (1680–1747) and Wernike (died about 1720). Among the satirists and epigrammatists Laurenberg (1591–1659), Rachel (1617–69), and Logau (1604–55) particularly distinguished themselves. The most successful novelists were Bucholz, Von Zesen, Shupp, Anton Ulrich, Duke of Brunswick, Scriver, Butschky, but more especially Moscherosch (1601–69), the author of the 'Wunderliche und wahrhafte Geschichte Philanders von Sittewald'; and Grimmelshausen (1625–76), whose 'Simplicissimus' is the most entertaining book of the century. In both the last-mentioned works are to be found interesting and vivid pictures of German life and manners during the Thirty Years' War. Among the scientific and philosophic writers of the period we may mention Kepler (1571–1631), the astronomer (who wrote in Latin); Puffendorf (1632–94), the publicist; Spener (1635–1705), the founder of the German pietists; and Reimarus (1694–1765). In philosophy and learning Latin had been hitherto the general medium of literature, and Jakob Böhme (1575–1624), the great mystic, stood almost alone in using the vernacular in communicating philosophical instruction. In the latter part of the century, however, appeared Christian Thomasius (1655–1728), an able jurist, pietistic philosopher, and writer, who established the first German learned periodical (Leipsic, 1688–90), and who first substituted his mother-tongue for the barbarous Latin of the schools in his philosophical lectures at Leipsic and Halle. Leibnitz (1646–1716) was the first to lay a scientific basis for the study of philosophy, but his works were composed chiefly in French and Latin. Wolff (1679–1754), his disciple, shaped the views of his master into a comprehensive system, and published his works in the German language.

Under the impulse of the new philosophical ideas Germany became, in the 18th century, excited on the subject of reform in literature, as it had been in the 16th on that of theology. The century opened with the foundation of the Berlin Academy by Leibnitz (1700). Gottsched (1700–66) labored in the same direction at Leipsic as Thomasius, exerting himself to make the German language the only medium of higher instruction, and publishing in it manuals of philosophy and science. His correct and formal taste led him to advocate the classical rules of composition of Racine and Corneille, and in religious and philosophical matters he in some measure sympathized with Voltaire. These leanings brought him into violent opposition with Bodmer (1698–1793) and Breitinger (1701–76), who admired the English poets as much as Gottsched did the French, and who were strictly orthodox in matters of religion. They carried on a paper war in their respective journals, until at length many who had rallied round Gottsched became disgusted with his pedantry and conceit, and separating themselves from him, established a periodical afterward well known in German literature, the 'Bremer Beiträge,' in which they opposed their former idol. At the same time they formed a poetical union, to which Hagedorn was friendly, although he never became a member, but which was eventually joined by Klopstock. Among the contributors to this journal were Rabener (1712–91), a popular satirist with a correct and easy style; Zachariä (1726–77), a serio-comic epic poet; Gellert (1715–69), the author of numerous popular hymns, fables, and a few dramas now forgotten; Kästner (1719–1800), a witty epigrammatist and talented mathematician; Giseke, Cramer, Fuchs, Ebert, and many others of more or less note. The journal was printed at Bremen, but the poets resided for some time at Leipsic, whence they adopted the name of the "Second School," while the followers of Bodmer styled themselves the "Swiss School." Related to the latter was the school of Halle, to which belonged Lange, Pyra, Uz, Götz, etc. The most distinguished poets of this school were Kleist (1715–59), who took Thomson, the author of the 'Seasons,' as a model, and Ramler (1725–98), the author of some fine odes; Gleim (1719–1803), a celebrated fabulist, at first a follower of Bodmer, gathered a nucleus of writers about him, and for about 40 years exercised considerable influence on German literature; but his fame was diminished by the criticism of Herder. Gessner of Zürich (1730–87) gained in his time a high reputation as a writer of idyls; but Herder thinks he has been much overrated. The poets of most influence and importance of the period, however, are Hagedorn (1708–54), whose fables and lyrics have rendered him immortal among his countrymen; Albert von Haller (1708–77), the eminent physiologist, who was remarkable as a writer of descriptive poetry; and greatest of all, Friedrich Gottlieb Klopstock (1724–1803), the author of the 'Messias,' the mystic and devout faith of which deeply impressed the world, while as a work of art it was thought to rival the epics of Milton and Dante. Strikingly opposed in style and spirit to this poem is the graceful Græco-Parisian epic, 'Oberon,' by Christoph Martin Wieland (1738–1813). But it was reserved for Gotthold Ephraim Lessing (1729–81) to give a new direction to German literature. He did for it what Luther had done for the language. He established a new school of criticism and dealt the fatal blow at French influence when Frederick the Great was courting the Gallic muse. Lessing's tragedy, 'Emilia Galotti,' his comedy of 'Minna von Barnhelm,' and his philosophic drama, 'Nathan der Weise,' are models of dramatic composition. He exerted a powerful influence on the drama by unfolding for the first time all the beauty, vigor, and originality of Shakespeare before the German mind, and by the profound and philosophical criticisms in his 'Dramaturgie.' He condemns all foreign models except the ancient classics and Shakespeare, and desires literature to reflect its own stirring energies in the drama as being the most perfect form, and not in the continental mediæval epic, which the spirit of the age shrinks from. Among the many literary labors with

which his name is associated, the most celebrated was a periodical, 'Literaturbriefe,' which he founded in 1759 in Berlin in conjunction with Nicolai, the publisher and author. The principal contributor after himself was his friend Moses Mendelssohn (1729–86), one of the noblest characters in the history of German literature. Both Klopstock and Wieland were criticised in that periodical, and it was the first to discover the merit of the unfortunate Winckelmann, the classic archæologist, and the philosophical genius of Kant, although at that time he had written but a few short treatises. Shortly after the commencement of this publication a new influence was brought to bear upon the literary world by Herder (1744–1803). His mind was a complete storehouse of universal knowledge; he had studied closely the poets of all nations, become intimately acquainted with the Hebrew, Greek, and Latin writers, and above all possessed a cosmopolitan humanitarian spirit, which, together with his poetical genius, manifested itself most suggestively in the crowning work of his life, the 'Ideen zur Philosophie der Geschichte der Menschheit.' He contributed in no small degree to the study of Oriental poetry, and was the first to direct attention to the beauty of the early popular songs of all nations, and particularly of his own. The earnestness and dignity of his character exercised a powerful influence upon the great poets of his time, and he succeeded in imbuing other minds with his poetical conceptions, both by his personal intercourse with them, and by his varied contributions to literature. The writings of Winckelmann (1717–68), in which are given the results of his studies of the remains of ancient art, modified all the old conventional theories of the beautiful, and by his exertions, combined with those of Lessing, whose 'Laokoon' was elicited by Winckelmann's suggestions, the spirit of art and poetry was brought back to the genuine and simple taste of the Greeks. The students of Göttingen University (then the most brilliant in Germany) became, through the teaching of Heyne, the accomplished critic and commentator, deeply impressed with the new ideas, and under the influence of the reforms which were then initiated in all departments of thought and life, founded in 1770 the 'Musenalmanach,' a literary journal, and not long afterward a poetical union known as the Göttinger Dichterbund or Hainbund. Among the members of the union were Gottfried Aug. Bürger (1748–94), author of 'Lenore' and other wild and picturesque ballads and songs; Voss (1751–1826), the translator of Homer, and author of one of the finest German idyls, 'Luise,' together with the two brothers Stolberg, Boie, Hölty, Claudius, Hahn, Cramer, Johann Martin Miller, etc. The Reformatory period was followed by a time of transition and excitement known in Germany as the "Sturm-und-Drang Periode," which found its fullest expression in the 'Leiden des jungen Werther' (Sorrows of Werther), one of the earliest works of Germany's greatest literary genius Johann Wolfgang von Goethe (1749–1832), and with more exaggeration and less poetic inspiration in the sensational tragedies and novels of Klinger (1753–1831), from one of whose dramas the period was so designated; and in the works of Schubart, Heinse, Lenz, and Müller. The literary excitement was driven to the highest pitch of excitement by the 'Räuber' of Friedrich von Schiller (1759–1805), afterward the friend and worthy coadjutor of Goethe. By the joint exertions of these two great men German literature was brought to that classical perfection which, from a purely local, has since given it a universal influence. Goethe possessed the plastic imagination of a Greek, the glowing fancy of an Oriental, and the melodic ear of an Italian, together with genuine German feelings. Versed in almost every human science, master in every department of literature, he became the acknowledged sovereign of intellectual Germany; while Schiller, by his enthusiastic and eloquent pleading for political and intellectual freedom, his wide human sympathy, and by the simple yet classical elegance of his style, became the favorite of the people. The contemporaries and immediate successors of Lessing, Herder, and Mendelssohn in the walks of science and philosophy and history are A. G. Baumgarten (1714–62), the founder of the science of Æsthetics, whose works are written in Latin; Meir, the popular interpreter of his ideas; Lavater (1741–1801), the physiognomist; Lichtenberg (1752–99), his keen and polished antagonist; the historians Mosheim (1694–1755), Dohm, Möser, Spittler, Johannes Müller; Adelung, the philologist; Basedow and Pestalozzi, the educationalists; Ernesti, Spalding, Rosenmüller and Michaelis, theologians; Eichhorn, in theology and universal and literary history; and the scientific writers Blumenbach, Euler, Vega, Herschel, and others. Closely related to the theological and psychological writers stand Nicolai, whose novel Sebaldus Nothanker satirized unsparingly the dead, hard dogmatism, or violent fanaticism of the narrow-minded and illiberal teachers of theology; Engel, the author of Lorenz Stark; Jacobi, the author of several metaphysical novels; Jung Stilling, the tailor, in whose autobiography Goethe took such a deep interest; and Jean Paul Friedrich Richter (1763–1825), who, possessing a deep fund of humor and pathos, and a wide experience of life, wanted in a painful degree the power of arranging his ideas, and often of lucidly expressing them in consequence. In the field of pure metaphysics Immanuel Kant was succeeded by Fichte (1762–1814), Hegel (1770–1831), and Schelling (1775–1854).

Partly produced by the influences of the "Sturm-und-Drang" period, and partly trained in the laws of art laid down and worked out by Goethe and Schiller, the so-called romantic school gradually succeeded in gaining public attention about this epoch and holding favor for a considerable time. The head of this school, Von Hardenberg, better known under the pseudonym of "NOVALIS" (1772–1801), was a poet and prose writer remarkable for scattered thoughts of wisdom and deep poetic insight, combined with morbid sentiment, and buried under a crude style. Diametrically opposed to him, although considered as belonging to the same school, is August Wilhelm von Schlegel (1767–1845), the author of the antique tragedy 'Ion,' and of many elegies and romances, but chiefly remarkable for his admirable metrical translation of Shakespeare, his critical and æsthetic writings on the drama, and his labors connected with the Indian and Sanskrit literature and language. The specialty of his equally eminent brother Friedrich von Schlegel (1772–1829) was the history of ancient and modern literature, and the

philosophy of history. The most original representative of the school was Ludwig Tieck (1773–1853), whose poetical dramatization and collection of fairy and popular tales reflect the romance of mediæval poetry with beauty and vigor, but with a mystic feeling akin to superstition. La Motte Fouqué is unrivaled in the power of giving Ariel-like delineations of the mysteries of fairy lore, instinct with grace, loveliness, and spirituality; as, for instance, in his 'Undine.' Chamisso (1781–1838), a sweet lyrical poet, and the author of 'Peter Schlemihl'; Tiedge (1752–1841), the author of 'Urania'; and Werner, a mystic religious poet, all belong to this school; and with the exception of the spirited poet Seume (1763–1810), and the Aristophanic Platen (1796–1835), most of the writers had a morbid passion for romantic and sentimental views of life. This epoch comprises the lyric poets Stägemann, Kosegarten, Baggesen, Matthisson, Salis, Mahlmann, and Eichendorf, many of whom belong to the romantic school. Among the novelists and tale writers are Achim von Arnim (1784–1831), and Clemens Brentano (1777–1842), the compilers of a collection of popular songs, 'Des Knaben Wunderhorn'; Ernest Hoffman (1776–1822), the author of the fantastic and wild tales 'Elixire des Teufels,' 'Kater Murr,' etc., which carry to a climax the supernaturalistic element of the romantic school; Musæus, the author of a collection of 'Volks-Märchen,' or popular fairy tales; Thümmel, Knigge, and Karl Immermann (1795–1840), the author of the famous novel 'Münchhausen.' Among female authors about this period, the most notable are Bettina von Arnim, Goethe's celebrated correspondent, and in the early part of her career associated with the romantic school; the Countess Ida von Hahn-Hahn, Auguste von Paalzow, Amalie Schoppe, Fanny Lewald, Johanna Schopenhauer, Frederike Brun, and others.

The war of liberation against Napoleon I. introduced a strong manly enthusiasm for a time into the hitherto gloomy and melancholy productions of the romanticists. The spirit of national liberty was roused and sustained by the stirring patriotic lays of Ernst Moritz Arndt (1769–1860); Theodor Körner (1791–1813), the gallant soldier poet, whose last song, the 'Schwertgesang,' had just left his hand when he had to grasp the sword for the heroic encounter with the hated French, in which he died, as he wished, a hero's death; Friedrich Rückert (1789–1866), the author of the 'Geharnischte Sonnette,' also celebrated for his versions of Oriental poetry and imitations of troubadour songs; Ludwig Uhland (1787–1862), whose ballads and metrical romances brought him a world-wide fame, and who was the recognized head of the modern Suabian school. This poetical union had its headquarters in Stuttgart, the seat of the great publishing firm of the Cottas, and the residence of the eminent critic Wolfgang Menzel. It counts among its members Gustav Schwab (1792–1850), Justinus Kerner (1786–1861), Gustav Pfizer, Eduard Mörike, Karl Mayer, etc. The efforts of Lessing, Herder, Klopstock, and others to revive the popularity of early German poetry, and to destroy the then prevailing taste for French and Italian literary forms, have contributed to give a powerful impulse to the researches into the ancient German literature, which was to some extent fostered by Jahn's spirited work on 'Deutches Volksthum.' The brothers Grimm — Jakob (1785–1863), Wilhelm (1786–1859), were the more immediate founders of this new branch of philological and poetic investigation. Among the many eminent names in general philology are those of Bopp, Pott, Schleicher, Steinthal, and Karl Brugmann.

The political excitement produced in Germany by the French July revolution (1830) gave a new direction to literary activity. A school of writers styled "Junges Deutschland," arose, in whose poems, dramas, and novels the social and political ideas of the time were strongly reflected. The forerunners of this party were Ludwig Börne (1786–1837), by his pungent political satires, and Heinrich Heine (1799–1856), a writer gifted with great penetration and political and philosophical insight. No writer except Goethe has been better able to introduce into lyrical poetry that language which seems to be the echo of the longing thoughts of the human heart, but he wilfully destroyed his own influence by his frivolity, sensualism, and irreligion. The most important member of the young German school was Karl Gutzkow (1811–78), author of several celebrated novels, 'Der Ritter vom Geist,' 'Der Zauberer von Rom,' etc., a popular dramatist, and one of the most active journalists of Germany. Among other notable representatives of the school are Mundt (1807–61), Kühne, Laube, and Wienbarg. Another eminent writer of this period is Baron Sternberg, whose novels reflect the social and political condition of his country; and closely related to him in tendency and aim stands Prince Pückler-Muskau. The taste for poems and novels of a social and political character has been gratified by Hoffmann von Fallersleben (1798–1874), Georg Herwegh, Dingelstedt, Kinkel, Prutz, Freiligrath, etc. Among other poets of the most recent period are Emmanuel Geibel, Grabbe, Gottschall, Paul Heyse, Wolfgang Müller, Bodenstedt, Anastasius Grün (Count Auersperg), Lenau, Otto Roquette, Karl Beck, Meissner, Redwitz, Kinkel, Zedlitz, Hamerling, Bishop Pyrker, Ambrosius, Baumbach, Becker, Bleibtrein, Holz, the brothers Hart, Redwitz, and Wolff. The most successful novelists of this or the immediately preceding generation are Karoline Pichler (1769–1843), Zschokke (1771–1848), Karl Spindler, W. Häring (1797–1871), the German Sir Walter Scott (famous under his pseudonym "WILIBALD ALEXIS"; Berthold Auerbach (1812–1882), the author of the 'Village Tales of the Black Forest'; Gustav Freytag, best known as the author of 'Soll und Haben' (known to English readers as 'Debit and Credit'); and the 'Verlorene Handschrift'; Gerstäcker, Wil. Hackländer, L. Schüking, Heyse, G. zu Putlitz, Mügge, O. Müller, Klaus Groth, Anzengruber, Elizabeth Bürstenbinder (Victor Werner), Dahn, Ebers, Eugenie John (E. Marlitt), Jensen, Keller, Kirschner, Kretzner, Lindau, Marie von Ebner-Eschenbach, Mailiff, Mauthner, Meyer, Ring, Rosegger, Baroness von Suttner, Storm, Sudermann, Spielhagen and Wilbrandt. Dramatic literature has fallen from the high estate which it reached through Lessing, Goethe, and Schiller. Their more immediate successors were Gerstenberg (1737–1823), Cronegk, Lesewitz, C. F. Weisse; Iffland (1759–1814), Werner (1768–1823), the founder of the 'Schicksalstragödie' (Fate Tragedy), by his piece called the 'Vierundzwan-

zigster Februar'; Kotzebue (1761–1819), one of the most prolific dramatic writers of all nations, having written in his short span of life about 200 pieces in all, some of which have been put upon the English stage; Karl Immerman (1796–1840); Raupach (1784–1852); Franz Grillparzer, Bauernfeld, Gutzkow, Benedix, Charlotte Birchpfeifer, Münch-Bellinghausen (better known as Fried. Halm), Laube, Hebbel, Gottschall, G. Freytag, Heyse, Greif, Ganghofer L'Arronge, Lindau, Moser, Hauptmann, Suderman, Wilbrandt, and Wildenbruch.

The tendency of the most eminent German minds has shown itself more and more in their partiality for the spheres of science and learning, rather than the poetic and dramatic department of literature. Alexander von Humboldt (1769–1859) gave a great impulse to almost all branches of knowledge by his 'Cosmos,' his 'Travels,' and his 'Views of Nature,' and by the general suggestiveness of his labors. While he marks a new epoch in the pursuit of the natural sciences, another great movement was initiated in historical researches by Niebuhr (1776–1831), the historian of Rome. Heeren (1760–1842) investigated history in connection with political and commercial relations. Other noted historians are Ranke, the historian of the popes; Dahlmann, Rotteck, Schlosser, Gervinus, the author of a 'History of German Literature,' and the historian of the 19th century; Lappenberg, author of a 'History of England,' completed by Pauli, which is considered a valuable work by English authorities themselves, Mommsen ('History of Rome,' etc.), Sybel ('French Revolution'), etc. Among the historians of literature are Von Hammer-Purgstall, an earnest student of Oriental literature, and author of histories of Turkish and Arabian literature; Julian Schmidt, who has written a history of German literature since the death of Lessing; and Heinrich Kurz and W. Wackernagel, historians of German literature, the work of the latter unfortunately uncompleted at his death in 1869. Another worker in the field of historical literature was King John of Saxony (1801–73), who, under the name of "PHILALETHES," published a metrical translation of Dante, enriched with many valuable notes and commentaries; and Eckermann, the compiler of the 'Conversations of Goethe,' while biography has been well represented by Varnhagen von Ense (1785–1858), Pertz, David F. Strauss, and others. The literature of travels — especially travels undertaken with scientific objects in view — was greatly stimulated, as already stated, by A. von Humboldt. Other names of note in this department of literature are Ida Pfeifer (1798–1858), the brothers Schomburgk, Lepsius, Brugsch, the brothers Schlagintweit, Barth, Vogel, Rohlfs, Schweinfurth, etc. We conclude with a list of eminent men in the principal departments of learning in Germany. In the natural sciences: Oken, Burmeister, Carus, Bern. Cotta, Ule, Endlicher, Bischoff, Kopp, Poggendorf, Wackenroder, L. von Buch, Naumann, Liebig, Erdmann, Helmholtz, Virchow, Schleiden, Grisebach, Vogt, Bessel, Brehm, Haeckel, Bastian, Sachs, etc. In medicine: Johannes Müller, Burdach, Ehrenberg, Hecker, Blasius, etc. In astronomy and mathematics: Bessel, Encke, Struve, Gauss, Mädler, etc. In geography, ethnology, and statistics: Karl Ritter, Wappäus, Petermann, Scherzer, Berghaus, Klöden, Stein, Streit, etc. In theology and biblical criticism: Baur, Bleek, Ewald, Strauss, Keim, Ritschl, Pfleiderer, Harnack, and others. Among historians of art there are Kugler, Burckhardt, Lübke, and others. In philosophy: Schopenhauer, Feuerbach, Rosenkranz, Kuno Fischer, von Hartmann, Lotze, etc. Consult: Histories of German literature by Bartels, Kurz, Wackernagel, Vilmar, Julian Schmidt, Koberstein, Gervinus (German poetry), Goedeke, etc.; and in English, Metcalfe's, Menzel's, Scherer's, Francke, Gostwick and Harrison's, Mac Callum, Wells, etc.

German Measles. This disease is acute, very contagious, and of unknown causation. It differs from measles in the mildness of its onset and symptoms, in the quicker appearance of the rash after the first signs of illness, and the more rose-red tint of the developed rash. It is distinguished from scarlet fever by its mildness of onset, the patchy character of the rash, without diffuse redness, and the shorter duration. The disease develops in 10 or 12 days after exposure, lasts about 3 to 5 days, and is followed by a moderate branny desquamation. Complicating bronchitis, pneumonia, gastro-intestinal catarrhs, and kidney disturbance may occur, but are infrequent.

German Ocean. See NORTH SEA.

German Silver, a white alloy for tableware, consisting of nickel, copper and zinc in various proportions. The best quality consists of four parts copper, two parts nickel, and two parts zinc, but this quality is the most difficult to work. For some purposes the proportion of copper is slightly increased, and for articles which are to be cast instead of stamped or hammered about 2 per cent of lead is added. To make a good malleable alloy, the three metals of which it is composed should all be of the best quality. It is harder and tougher than brass, and takes a fine polish. In color it is sufficiently near silver to make it valuable for plating with that metal. This, together with its hardness in resisting wear, has caused a great demand for German silver for certain wares made in Birmingham and Sheffield.

Spoons and forks of this alloy are made in immense numbers. Such articles as salvers, dish-covers, jugs, teapots and the like are also largely made of it, but these objects, or at least some of them, are still more largely made of a greatly inferior alloy, because much softer. German silver has a coppery odor and is readily attacked by acid liquids, such as vinegar, which coat it with verdigris. Spoons and forks made of this alloy should therefore either be plated with silver or carefully kept clean. Of late years, through care in preparing a suitable alloy, large objects, such as the bodies of jugs and coffee-pots, can be formed of sheet German silver by "spinning" it on the lathe, instead of by stamping or by the slow process of hammering. Formerly it was only a soft alloy that could be so treated. For some time past there has been a tendency to substitute for electroplate — that is, German silver plated with real silver — white alloys having nickel for their basis. These, however, are but varieties of German silver known under different names, such as silveroid, argentoid, navoline, and nickeline. Some of them contain small quantities of tin, cadmium, and other metals. Mountings for ship-cabins,

bar-fittings, forks and spoons, and other similar articles have been manufactured on a considerable scale from these new alloys. See ELECTROPLATE; METALS.

German Southwest Africa, a German protectorate in West Africa, coast extending from Cape Frio to Walfisch Bay, inland to lon. 20° E.; area, estimated, 322,450 square miles. Coast infertile and desolate; inland are richer tracts. Damaraland is the name of the north district, Namaqualand and Luderitzland lying to the south. Damaraland is occupied by the Southwest African Company, an Anglo-German syndicate, which was formed in London in 1892, and obtained from Berlin a concession to search for and work the minerals of the district, including the copper mines of Otavi, but outside of the district worked and occupied by the German Southwestern Africa Colonial Company, which district consists chiefly of the coast lands. The German government, owing to complaints that too great favor had been shown to the Anglo-German Company, decided to give preference to German settlers, and to reserve certain parts of the country for them for 10 years. The country is apparently rich in copper and in agricultural resources, though undeveloped. The seat of administration is at Great Windhoek, 170 miles inland from Walfisch Bay. The German government decided in 1897 to commence the building of a railway from the coast to the interior. Pop. (1900) 221,000.

Germander, jėr-man'dėr (*Teucrium*), a large and widely distributed genus of labiate herbs, of which all the European species are of old medicinal repute on account of their aromatic bitter and stomachic properties. The species are numerous. The wall germander or true germander (*T. chamædrys*), often found on ruined walls, has probably been introduced from Europe. Wood germander or wood sage (*T. scorodonia*) is a very common British plant, in dry bushy or rocky places. It is very bitter and slightly aromatic. It is used in the Island of Jersey as a substitute for hops. Water germander (*T. scordium*), in wet meadows, has a smell like garlic. Cat or sea thyme (*T. marum*), of southern Europe, like catmint and valerian root, has great attractiveness for cats. It is still sometimes used in the preparation of sneezing powders. The American species (*T. canadense*) is also known as wood sage.

German'ia, a country of ancient Europe. See GERMANY.

German'icus Cæsar, Roman general: b. 15 B.C.; d. Epidaphnæ, near Antioch, 9 Oct. 19 A.D. He was the son of Nero Claudius Drusus, and of Antonia, daughter of Mark Antony and niece of Augustus. By desire of Augustus he was adopted in the year 4 A.D. by Tiberius, whom he accompanied in the war against the Pannonians, Dalmatians, and Germans. In the year 12 he was consul, and next year was appointed to the command of the eight legions on the Rhine. He was at Lugdunum Batavorum when news came of the death of the Emperor Augustus and of the mutiny for more pay and shorter service among the soldiers in Germany and Illyricum. Germanicus hastened to the camp and quelled the tumult by his personal popularity; and at once led his soldiers against the enemy. Crossing the Rhine below Wesel, he attacked and routed the Marsi, and next year marched to meet the redoubtable Arminius (q.v.), the conqueror of Varus and his legionaries, whose bones had lain unburied for six years in the Teutoburg Forest. With solemn rites his soldiers buried these sad relics of disaster, then advanced against the foe, who, retiring into a difficult country, managed to save himself, and was not subdued till the year after, when Germanicus again carried a part of his army up the Ems in ships, crossed to the Weser, and completely overthrew Arminius in two desperate battles. Tiberius, jealous of the glory and popularity of Germanicus, recalled him from Germany in the year 17, and sent him to settle affairs in the East, at the same time appointing as viceroy of Syria, in order secretly to counteract him, the haughty and envious Cn. Calpurnius Piso. Germanicus died, probably by poison. His wife, Agrippina, and two of her sons were put to death by order of Tiberius; the third son, Caligula, was spared. Of the three daughters who survived their father, Agrippina was as noted for vice as her mother for virtue.

Germanium, jėr-ma'nĭ-ŭm, a metallic chemical element discovered in 1886 by Dr. Winkler in a silver ore (argyrodite); symbol, Ge; atomic weight, 72.3. It has a melting-point about 1,650° F. (900° C.); is oxidized when heated in air; crystallizes in octahedra; has a perfectly metallic lustre, and is of a grayish-white color. As gallium had been named from France, the new metal was named after Germany. Fifteen years before its discovery its existence was prophesied by Mendeleëff as required to fill the gap in the periodic table between silicon and tin.

Germans in the United States, The. The German immigration hither may be roughly divided into two sections, as a whole or more than formal difference in their effect on us and themselves, though of course divided by no exact line; before the Revolution and after it. The colonial immigration created settlements in great part purely or dominantly German, and still retaining frequently German names and deeply German characteristics; and in one remarkable case, that in eastern Pennsylvania, a great agricultural district in many things tenaciously German still. The later migration has mostly coalesced with our own people, though in some cities so great as to give them unmistakably German characteristics.

Colonial.— The first German immigrations were predominately religious, like the English to New England; by far the greater part were sectaries from the Rhine country, the home of Mysticism and Pietism. So many were from the Palatinate that all German immigrants were called «Palatines» in America. Persecution was the usual cause; sometimes, as with the Dunkers (see GERMAN BAPTIST BRETHREN), rather a desire, supplemented by material hardships, for a settlement devoted purely to their own faith. The poverty and misery left by the Thirty Years' War, but slowly changed under a series of extremely bad rulers, also drove great numbers to emigrate. The immediate stimulus was William Penn's visit to Germany in 1677; he saw the conditions there, and on receiving his grant of Pennsylvania in 1681, wrote to Benjamin Furly recommending it as an asylum for oppressed sects. Literature about Pennsylvania and the Quakers soon abounded, and Furly founded two

emigration companies, one at Crefeld on the Rhine and one at Frankfort-on-the-Main. The first emigrants were Mennonites (q.v.), from Crefeld, led by Francis Daniel Pastorius (q.v.), probably about 40 in all; they sailed in the Concord, their Mayflower, and landing at Philadelphia 6 Oct. 1683, settled at the later Germantown (q.v.), incorporated 1691, but dissolved soon after because no one would hold office. These were they who, in 1688, signed the first anti-slavery petition in America. The settlement of Labadists (q.v.) at Bohemia Manor in Maryland, was mainly Dutch, but contained some Germans. In 1694 the millennial society afterward nicknamed the "Woman in the Wilderness," a mixture of Rosicrucianism, Mysticism, Pietism, etc., settled as hermits on the Wissahickon, but scattered on the death of their leader, Kelpius. From 1705 to 1710 a body of German Reformed settled German Valley, Morris County, N. J.; and coming in large numbers later, they spread from the Delaware to Hackensack, centring at German Valley and New Germantown. On the last day of 1708, 61 Lutherans from Landau, ruined by the devastations of the War of the Spanish Succession, settled Neuburg (Newburg), N. Y., but failed and scattered. The same cause, however, added to the terrible cold winter of 1708–9, which destroyed the vines and fruit-trees, led to a tremendous exodus to England, some 15,000 in all flocking over and living in camps, in dreadful misery and destitution, and many dying. Some thousands were colonized in Ireland, other thousands of Catholics who refused to become Protestants were deported back to Germany, 4,000 or 5,000 ultimately came to America. One colony, under Baron de Graffenried, were settled in North Carolina at the confluence of the Neuse and Trent, naming the place New Berne (Newbern); many were massacred by the Tuscaroras, and part removed to Virginia, where Spotswood settled them at Germanna. The largest single body, however, was settled on both sides of the Hudson at West Camp (Saugerties) and East Camp; the latter was broken up, part founded Rhinebeck, and others took lands from the Mohawks, and founded Schoharie. The government would not recognize the title to the latter, and repeatedly granted the lands over their heads. At last, worn out, part of them migrated to the Mohawk Valley, where their growth and the stream of German emigrants that followed made it "for 30 miles a German river"; Herkimer, German Flats, Mannheim, Oppenheim, Minden, Palatine Bridge, etc., livingly commemorate them. But the greater portion removed to Pennsylvania in 1723 and settled at Tulpehocken Creek, the western outpost of the present Berks County; the eastern part had been settled by another band five years previous, and the district rapidly filled up between into a German stronghold, for some reason mainly Lutherans. Meantime the original Mennonites had spread over the present Montgomery County; and in 1709 eight families had taken lands on Pequæ Creek, now in Lancaster County, some 60 miles from Philadelphia. Renewed persecutions of the Mennonites by the Swiss drove them first to Holland, then in 1717 to their brethren in Pennsylvania, settling on Pequæ; in 1726 another large body came over — the last two by aid of a "Committee of Foreign Needs" in Rotterdam, which in 1732 declined to extend further aid. These made Lancaster a German district. In 1719 and 1729 the Dunkers removed bodily from Germany, but seem to have settled among others rather than founded new places. It was among them at Pequæ that Conrad Beissel first sojourned, before founding his convent of Ephrata, which seems to have been confounded with Dunker practices. In 1733 the Schwenkfelder, followers of Caspar Schwenkfeld, after undergoing frightful persecutions in Silesia from the Emperor Charles IV. to make them turn Catholics, came to Pennsylvania and settled along the Perkiomen in Montgomery County. The Germans now formed the deep and populous frontier of Pennsylvania. The earliest settlement of Lebanon and Dauphin counties was begun at Quitapahilla or "Snakes' Hole"; about 1720 a Jewish colony was planted near Schaefferstown. Across the Susquehanna, the first white settlement of York and Adams counties was founded in 1730 by Germans at Conewago. In 1732 the German swarms crossed the border: a band entered the valley of Virginia, and within a generation the Germans were all through the valley, and had founded three towns — Strasburg, Mecklenburg (renamed Shepherdstown from its founder, Schaeffer, translated Shepherd), and Woodstock. Others settled near Frederick, Md., and in 1735 an organized band came thither under John Thomas Schley, who built the first house in Frederick (laid out 1745). In 1739 Jonathan Hagar came to his tract of "Hagar's Choice," and in 1769 founded Elizabethtown, renamed by the people Hagerstown. By this time the Germans had filled western Maryland between South Mountain and the Conococheague, founding several towns, including Graceham of the Moravians. The trading road between the Maryland German settlements and the valley of Virginia was the chief emigrant road. The first German settlement in South Carolina was in 1731, at Purysburg on the Savannah, the work of a promoter with purely business ideas; but it was too malarious, and did not prosper. In 1735 a large emigration fixed on Orangeburg district (named later from the Prince of Orange); other bands followed rapidly, and in a few years some 20 colonies had established themselves there — Amelia, Saxe-Gotha (now Lexington), Fredericksburg, etc. By 1775 they had spread over all western South Carolina. About 1750 a colony settled at "Dutch Forks" (Saluda and Broad, Newberry County); the latest one was at "Hard Labor Creek," Abbeville County, the speculation of a rascally officer who left his colonists to starve in England, but they were rescued and forwarded by benevolent Englishmen. The first Georgian settlement was in 1734. It was of Lutherans from Salzburg in Austria, persecuted by the Roman Catholic archbishop; and with Oglethorpe they selected a site 25 miles up the Savannah, which they called Ebenezer. The next year others came; and in 1736 the "Great Embarkation" of Salzburgers, Moravians, and German soldiers for Fort Frederica on St. Simon's Island, to be an outpost against the Spaniards. The latter soon disappeared; the former settlement was infertile, unhealthy, and ill-placed for trade; and a new location was found which proved satisfactory. By 1741 there were about 1,200 Germans, Swiss, and Palatines in Georgia. In 1752 a large band of Würtembergers came

to the district and founded St. Matthæus's parish. There were many Germans in Charleston and Savannah; and isolated settlements in the Carolinas besides those mentioned; and a great southern movement of the Pennsylvania Germans was proceeding along the Maryland and valley of Virginia trail, filling the mountain counties of North Carolina with German settlers. That province thus had a strip of English colonization on the coast, then one of German, then a third of Scotch-Irish, then a fourth of Germans again. Meantime the Georgia Moravians had left there on being required to fight the Spaniards, and coming to Pennsylvania, were given by George Whitefield a tract near the "Forks of the Delaware" (Easton), which they named Nazareth; quarreled with their leader as to a "limited atonement"; Whitefield turned them out in midwinter, and they secured another site, which they called Bethlehem. Zinzendorf came thither in 1741. (For their Indian mission work, see their name; for the tragedy of the Delaware towns, see GNADENHÜTTEN.) After the close of the French and Indian war, the Germans speedily filled up western Pennsylvania, first opened to white settlement by the Albany Treaty of 1754, but kept closed by the war. Some of these counties are still full of German names, as Berlin, Pfautz Valley, etc. Two minor items may be mentioned, in earlier chronological order. In 1719 John Law, as part of his Mississippi Bubble, sent a colony of Germans to Louisiana, where they settled in the present Arkansas; but on Law's collapse they grew frightened and went to New Orleans to take ship for home again. The French government, however, would not let them go, and resettled them at Côte d'Allemande (Germans' Shore). In New England two feeble attempts were made at Waldobore, Me. (from Gen. Waldo, descendant of a Von Waldow), and Braintree, Mass. (at New Germantown). Both were unprosperous; the latter joined the former, which finally broke up, and the settlers went to North Carolina.

Later.— Of the overflow from the Atlantic States which began to populate the new West as soon as it was opened to settlement — the first wave after the Revolution, the second after the War of 1812 and the surrender of the frontier posts — the Germans were a considerable portion as being already in mass on the frontiers; so that the first tier of Western States had a heavy German strain before the new foreign emigration began in some force about 1820, when the Bureau of Immigration was established. But for the first decade the volume was small, only 6,761; and in the early thirties it continued slender. Then it rose greatly under the bad industrial conditions and political repression of the people, and amounted to 152,454 in 1821–30; thence on in mighty volume, the figures are, for the German empire alone, 1841–50, 434,626; 1851–60, 951,667; 1861–70, 787,468; 1871–80, 718,182; 1881–90, 1,452,970; 1891–1900, 543,922. No definite reason is assignable for the enormous leap in the last decade but one, followed by a decrease nearly back to the figures of half a century before. Since 1900, about 100,000 more have come over. Besides these, German Austria has sent us about 500,000. In all, besides the immense German element already existent in the population, some 5,700,000 have been added to it straight from the old country since 1820. In 1900, of the German-born population in the United States (2,943,239 from Germany and German Austria), about 33 per cent were in the North Atlantic States, and 55 in the Central West. New York State came first, with 558,517; then Illinois, with 350,381; Wisconsin, with 250,096; Ohio, with 215,735; Pennsylvania, with 279,945; New Jersey, Iowa, Minnesota, and Missouri having well over 100,000 apiece. Of the cities, New York had 393,770, or over one ninth of its population; Chicago 182,553, or nearly one ninth; Philadelphia, 76,473; St. Louis, 61,-344, nearly one ninth; Milwaukee, 55,470, or nearly one fifth — by far the heaviest percentage of any city in the United States; Cleveland, 45,278, or toward one eighth; Cincinnati, 38,873, or between an eighth and a ninth — its great German stock belonging mostly to the last generation; Buffalo, 37,496, or between a ninth and a tenth; San Francisco, 37,035, or nearly one ninth; Baltimore, 34,564; Detroit, 32,498, or a little over one ninth. The tenacity of this percentage is most curious.

Ger'mantown, Pa., a former village, since 1854 the 22d ward of Philadelphia. Considerable historical interest is attached to the place. It was settled by the Germans, under a grant from William Penn, in 1684, and on 4 Oct. 1777 a battle took place between the armies under Washington and the English under Howe. See GERMANTOWN, BATTLE OF.

Germantown, Battle of, 4 Oct. 1777. Howe having captured Philadelphia, stationed his army across the Germantown road north of the city and east of the Schuylkill; the left wing with its supports on the river, the right "in the air" to the east. He shortly detached part of it to reduce the forts which blocked the Delaware below the city; and Washington planned the capture of the weakened army, starting after dark on the evening of 3 October. His right under Sullivan and accompanied by himself, with six brigades, was to move down the main street and crush the British left; the Pennsylvania militia to march along the river and take it in flank; the left under Greene was to divide, three brigades under himself taking the British right in front and flank, while two others were to move to the east and come up in its rear. This would drive it back upon the left and both on the river, and it was hoped would compel surrender. A mile or so north of the British centre on Mount Airy, were a battalion of light infantry and a battery; in a field just left was a regiment under Col. Musgrave; a little south on the main road was the massive stone house of former Chief Justice Chew. At sunrise a heavy fog came up and left all darker than ever. The British advance bodies were overwhelmed by the Americans, and the battery captured; but Musgrave took shelter in Chew's house, and after an unsuccessful attempt at breaching it with the light guns, the Americans left a brigade to besiege it and pushed on. Despite this delay and the warning to the British, both their wings soon began to give way before the American onset. But in the fog, the heavy firing at Chew's house drew Gen. Stephen with his brigade, on Greene's right, too far west, thinking the main fight was there; and Wayne on Sullivan's left had turned considerably east and came in front of Stephen, who took him for

the enemy and attacked him in the rear. Wayne's men were driven against the next left of Sullivan's remaining brigades, a panic started, and a general retreat began. The British took the offensive, and reinforced by Cornwallis from Philadelphia, pressed the Americans hard; but the latter soon regained composure and retired in good order, though one regiment of Greene's was surrounded and captured. The Americans, however, brought away several captured cannon, and all their own and their wounded. Their loss in killed and wounded was 673, the British 535. Stephen was accused of having drunk too much on the night march, court-martialed, and dismissed from the army. Despite the failure of the plan, the ultimate results were very great. The audacity of the Americans in attacking the British so soon after the defeat of the Brandywine, and the fighting qualities displayed, were a large factor in determining the French alliance.

Germany (Latin, *Germania;* German, *Deutschland;* French, *Allemagne;* Spanish, *Allemania*), the name given to a large part of Central Europe, and in one sense including all the countries in which the mass of the people are German in race and language. Parts of Switzerland, Austria, and Russia may thus be said to be German. The name, however, in its usual and more restricted application, is confined to those states which constitute the German Empire. Taken in this sense, Germany from east to west is about 750 miles long, and from north to south 600 miles. It is bounded on the north by the Baltic, Denmark and the North Sea, the Baltic coast measuring 830 miles, the North Sea coast 300 miles, and the northern land boundary of Schleswig 53 miles; on the west it is bounded for 512 miles by Luxembourg, Belgium, and Holland; on the southwest and south by Austria and Switzerland for 1,170 miles, also on the southwest by France for 275 miles, and on the east by Russia for 725 miles. The table in the next column shows the political divisions which constitute the German Empire, with their respective areas and population.

The small island of Helgoland, now forming part of Prussia, was added to the empire in 1890. As each state is described under its own name, the description here is confined to leading features which belong to Germany as a whole.

Topography.— The physical features are greatly diversified and present an irregular succession of mountains and valleys, table-lands and plains, making it extremely difficult to arrange them for the purpose of a distinct general description. The whole country may, however, be considered as consisting of a mountain region in the south with a great north plain between it and the sea. This mountain region does not in average height exceed 5,000 feet and is extremely complicated, consisting of a great number of separate ranges, which ramify in all directions and become so interlaced with each other that the limits assigned to them are in many instances arbitrary. The only range which has any title to be considered as a common centre is the Fichtelgebirge, continued east by the Erzgebirge and the Riesengebirge, southeast by the Böhmerwald, west by the Thüringerwald, Rhöngebirge, and Spessart, and carried to its northern limit in the Harz. The western boundary of this region is formed chiefly by the Schwarzwald and Odenwald. Across the Rhine are the Vosges Mountains on the French frontier. The great plain in the north extends without interruption to the German Ocean and the Baltic and flattens down so much when it approaches them as in many places to require artificial protection from their waves. Its length west to east may be about 550 miles, and its average breadth 200 miles.

Political Divisions	Area in sq. m.	Pop. Dec. 1, 1900
Kingdoms		
1. Prussia	134,603	34,472,509
2. Saxony	5,787	4,202,216
3. Bavaria	29,282	6,176,057
4. Würtemberg	7,528	2,169,480
Imperial Territory		
5. Alsace-Lorraine	5,600	1,719,470
Grand Duchies		
6. Baden	5,821	1,867,944
7. Hesse	2,965	1,119,893
8. Mecklenburg-Schwerin	5,135	607,770
9. Mecklenburg-Strelitz	1,131	102,602
10. Oldenburg	2,479	399,180
11. Saxe-Weimar	1,388	362,873
Duchies		
12. Brunswick	1,424	464,333
13. Saxe-Meiningen	953	250,731
14. Saxe-Coburg and Gotha	755	229,550
15. Saxe-Altenburg	511	194,914
16. Anhalt	906	316,085
Principalities		
17. Waldeck	433	57,918
18. Lippe	469	138,952
19. Schaumburg-Lippe	131	43,132
20. Schwarzburg-Rudolstadt	363	93,059
21. Schwarzburg-Sondershausen	333	80,898
22. Reuss (elder line)	122	68,396
23. Reuss (younger line)	319	139,210
Free Towns		
24. Bremen	99	224,882
25. Hamburg	158	768,349
26. Lübeck	115	96,775
	208,830	56,367,178

Hydrography.— The central mountain region and plateau forms part of the great watershed of Europe and either gives rise to more than one of its most important rivers or sends them their principal affluents. Thus the Danube, rising near its extremity, flows across it in an easterly direction, and does not quit it till it about reaches the extreme east of Bavaria. The Rhine, in like manner, though it neither rises nor terminates within Germany, flows within it for the greater part of its course and is considered by the Germans as their national river par excellence. After these come the Elbe, strictly speaking the greatest river of Germany, inasmuch as almost its whole basin lies within it; the Oder, Weser, Main, Neckar, Mosel, Ems, and Eider — all of which are navigable. The principal lakes are the Lake of Constance or the Bodensee, 1,306 feet above sea-level, between Würtemberg and Switzerland, and the Amersee, the Wurmsee, or Starnberg Lake, and the Chiemsee in Bavaria.

Geology.— The central highland consists principally of Cretaceous, Jurassic, and Triassic formations. The northern plain, to all appearance, was once covered by the sea, alluvial deposits of great depth being spread over almost every part of its surface, but generally with so large a proportion of sand as to make it for the most part naturally unfertile. Considerable Devonian and Silurian areas extend over the middle

Rhine region while Quaternary formations occur on the north and Tertiary on the south. South of the Weser highland is a great central area composed chiefly of Triassic rocks, while on the west is a Cretaceous zone. The Vosges Mountains west of the Rhine valley, and the Black Forest on the east comprise large areas of crystalline rocks. Dyassic and coal formations are found in the Oldenburg and in the Ruhr regions.

Mineral Resources.— Germany possesses varied mineral riches, the most important of which are common coal and brown coal, iron, zinc, lead, and salt. In respect of its mineral wealth the Prussian monarchy takes a prominent place among the states of Europe, especially in the production of zinc. After Prussia the kingdom of Saxony is the most important mining country in Germany. Gold and silver are obtained in the Harz Mountains and in the kingdom of Saxony; gold to a limited extent also in Bavaria. Iron is chiefly obtained in Prussia, Alsace-Lorraine, Bavaria, Brunswick, and Saxony. Copper, lead, and zinc are found chiefly in Prussia. Tin is found only in the kingdom of Saxony; quicksilver, antimony, and sulphur are mainly confined to Prussia; nickel and alum are obtained chiefly in the same state; arsenic chiefly in Saxony, graphite in Bavaria, and blue and green vitriol in Prussia and Saxony. The most extensive coal beds lie in the kingdoms of Prussia and Saxony. Brown coal is obtained also in the duchy of Anhalt. Rock salt is obtained in considerable quantities in Prussia, Anhalt, and Würtemberg. Marble, alabaster, kaolin, calamine, molybdenum, cinnabar, lime, asbestos, slates, millstones, freestones, trass, and sundry precious stones — as amethysts, garnets, etc.— are also found in various localities. Germany is likewise extremely rich in mineral waters, including chalybeate, sulphurous, alkaline, saline, and warm of all kinds.

The quantity of minerals produced in 1900 is shown in the following table:

	Tons
Coal	109,290,200
Lignite	40,498,000
Iron ore	18,964,300
Zinc ore	639,200
Lead ore	148,300
Copper ore	747,700
Rock salt	926,600
Potassic salt	3,050,600
Gold, nickel, bismuth and other products	401,900
The total value was about	$315,000,000

Soils.— The alluvial soil of the Rhine valley is the richest in the country, and here the vine is extensively and profitably cultivated. The soils of the southern river valleys are also remarkable for their fertility. The great northern plain, although consisting of an alluvial glacial deposit, has a poor soil owing to the large admixture of Quaternary sands, necessitating careful tillage and artificial fertilization to attain any degree of productivity. With the exception of the hills and mountains, which are densely wooded, the rest of the country consists largely of extensive tracts of sterile plateau and moorlands.

Climate.— The climate of Germany is fairly uniform throughout, the lower latitude of the southern portions being compensated by greater elevation above the level of the sea. January is always the coldest month, its mean temperature being generally below freezing point, except on the North Sea coast, the northwestern plain, and the Upper Rhine valley. The mean temperature of the warmest month (usually June) generally ranges from 60° to 66° F. The range of mean annual temperature is from 36.3° on the Brocken to over 50° in the Upper Rhine valley and parts of Bavaria. The greatest annual rainfall is that of the Upper Harz region (67 inches); for Rhenish Prussia and Westphalia it is 41 inches, for the Upper Rhine valley from 23 to 27, and rather less for the Berlin region. The best climates are those of the Upper Rhine valley, and the valleys of the Moselle, Main, and Neckar.

Forestry.— About a quarter of the surface is under forest, the largest proportional amount being in Hesse-Nassau. The chief trees are the beech and oak, mainly in the west; pines, chiefly on the northern plain; firs, in the mountainous districts; birch and alder, chiefly in the north; larch, on the southern mountains; and chestnut, in the Upper Rhine valley. Forestry as an industry is under the protection of the state, conducted under scientific methods, and yields to Prussia, for instance, from forests and domains, an average annual revenue of $20,000,000.

Flora.— Germany belongs entirely to the region of the middle European flora, and is crossed by the northern limit of vine cultivation (about lat. 51°–52° N.). The total number of flowering plants in its flora is about 2,500.

Fauna.— There are three faunal zones — Alpine, Upper German, and Lower German — the first being the richest. The fauna is mainly a forest one, and includes 65 mammals and 225 birds. Notable species are the wolf, badger, mink, beaver, wild cat, wild boar, elk, bear, and one kind of tortoise.

Fisheries.— These are comparatively unimportant. The river waters abound with the salmon tribes, together with carp, pike, eel, roach, and perch, giving employment to some 20,000 persons, while about 12,000 persons are engaged in the deep-sea and shore fisheries, chiefly for cod and herring in the North and Baltic seas.

Land Tenure.— With the exception of the Mecklenburg grand duchies, unhampered free trade in land has been legally enacted throughout the German empire. Large estates are held in the northeast, while peasant proprietorship and small estates are general throughout the west German states.

Agriculture, etc.— Germany is becoming less and less an agricultural and more and more a manufacturing nation, but in many parts agriculture is still the main business of the population. About 65 per cent of the total area is under cultivation, and of this more than half is under the chief cereals, fully a sixteenth under other corn crops and leguminous plants, nearly a sixth under potatoes, turnips, sugar beet, cabbages, etc., while less than a fiftieth represents orchards and gardens. The empire does not now grow the cereals in sufficient quantity to meet its own requirements, but is becoming increasingly dependent upon imports, especially of wheat and barley from Russia, Hungary, Rumania, and North America. Of the chief cereals, rye occupies the largest area, and next in order come oats, wheat, barley. Spelt is grown in the south and maize also to a small extent. Buckwheat is a northern crop, and potatoes, though grown all over the empire, are most widely cultivated in

the north. Flax and hemp thrive best in the central mountainous districts. Hops are raised chiefly in Bavaria (Main valley below Nuremberg), Baden (Carlsruhe district), Hagenau district west of the Rhine, Würtemberg, and Posen; sugar beet in an extensive region from Leipsic to Brunswick, including Madgeburg and Halle, around Bautzen in the Breslau-Liegnitz district, near Danzig, Neu-Strelitz, Bromberg, Frankfort-on-the-Oder, etc.; tobacco chiefly in Baden, the Bavarian Palatinate, and Brandenburg. The yield of the principal crops in 1901–2 was as follows:

	Tons
Wheat	2,498,851
Rye	8,162,660
Barley	3,321,102
Oats	7,050,153
Potatoes	48,687,261
Hay	22,373,047

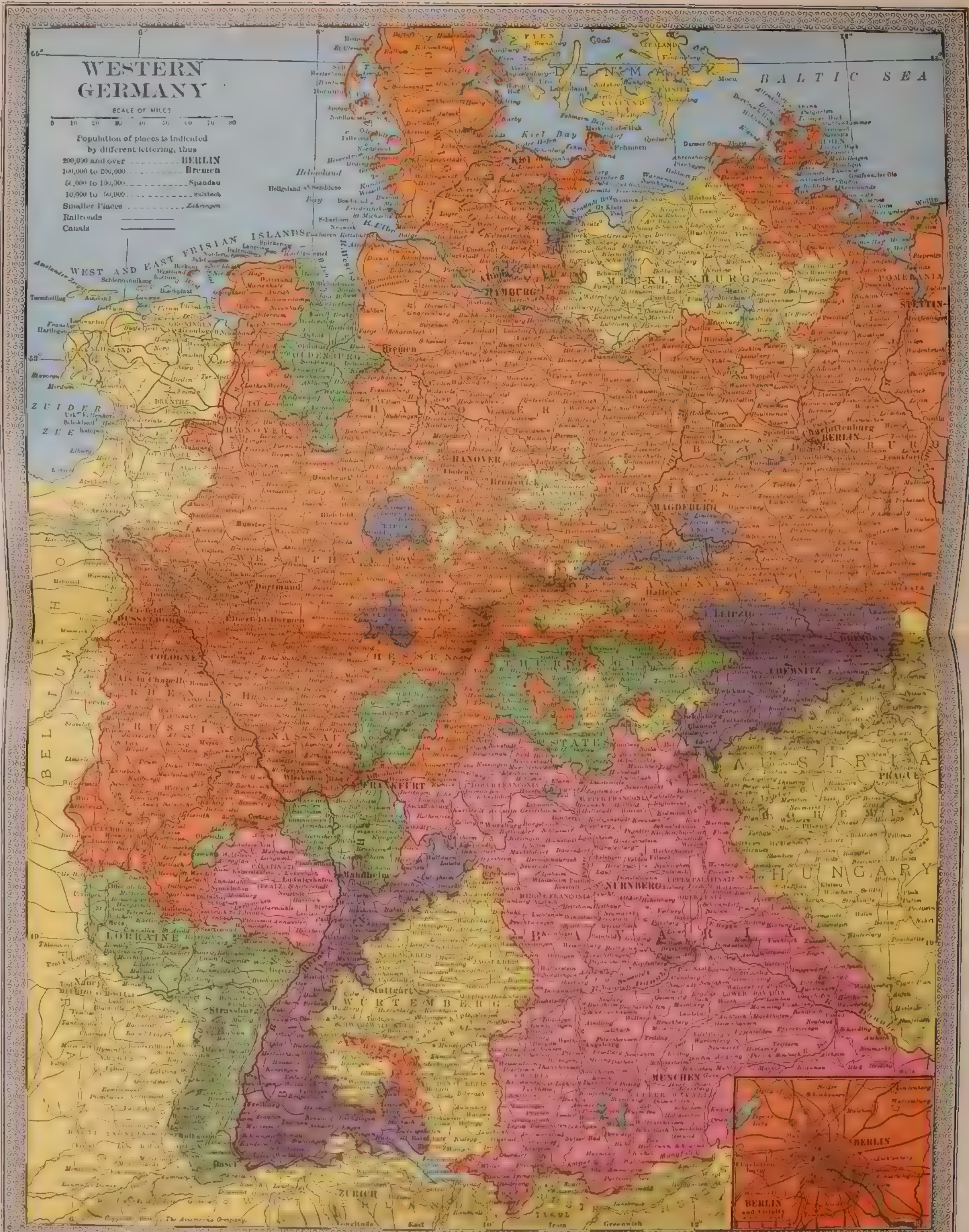
The chief wine-growing region is the Rhine valley from Baden to Cologne, with the valleys of the Moselle and the Neckar; but other important districts are the Main valley about Würzburg, the valley of the Saale in the Naumburg-Weissenfels district, the Elbe valley at Dresden, parts of the Rhine valley above Strasburg, and a small district north of Görlitz. The growing of vegetables and market gardening generally is most extensively carried on around Berlin, Dresden, Leipsic, Erfurt, Hamburg, Brunswick, and Düsseldorf. Fruit-growing is most successful in the middle and south of the empire, especially in Saxony, Franconia, and the middle Rhine valley.

Stock-raising.— Good horses are reared in the provinces of East and West Prussia, Mecklenburg, Holstein, and Hanover; cattle thrive best on the North Sea coast, in Franconia, the Vogtland, and the Alpine districts; sheep-breeding is declining, but good wool is still obtained from Saxony, Silesia, and Brandenburg. Swine are bred chiefly in Westphalia, Mecklenburg, Pomerania, Bavaria, and Prussian Saxony. The number of domestic animals in Germany in 1900 was estimated at: cattle, 18,939,692; swine, 16,807,014; sheep, 9,629,501; horses, 4,195,361; goats, 3,266,997.

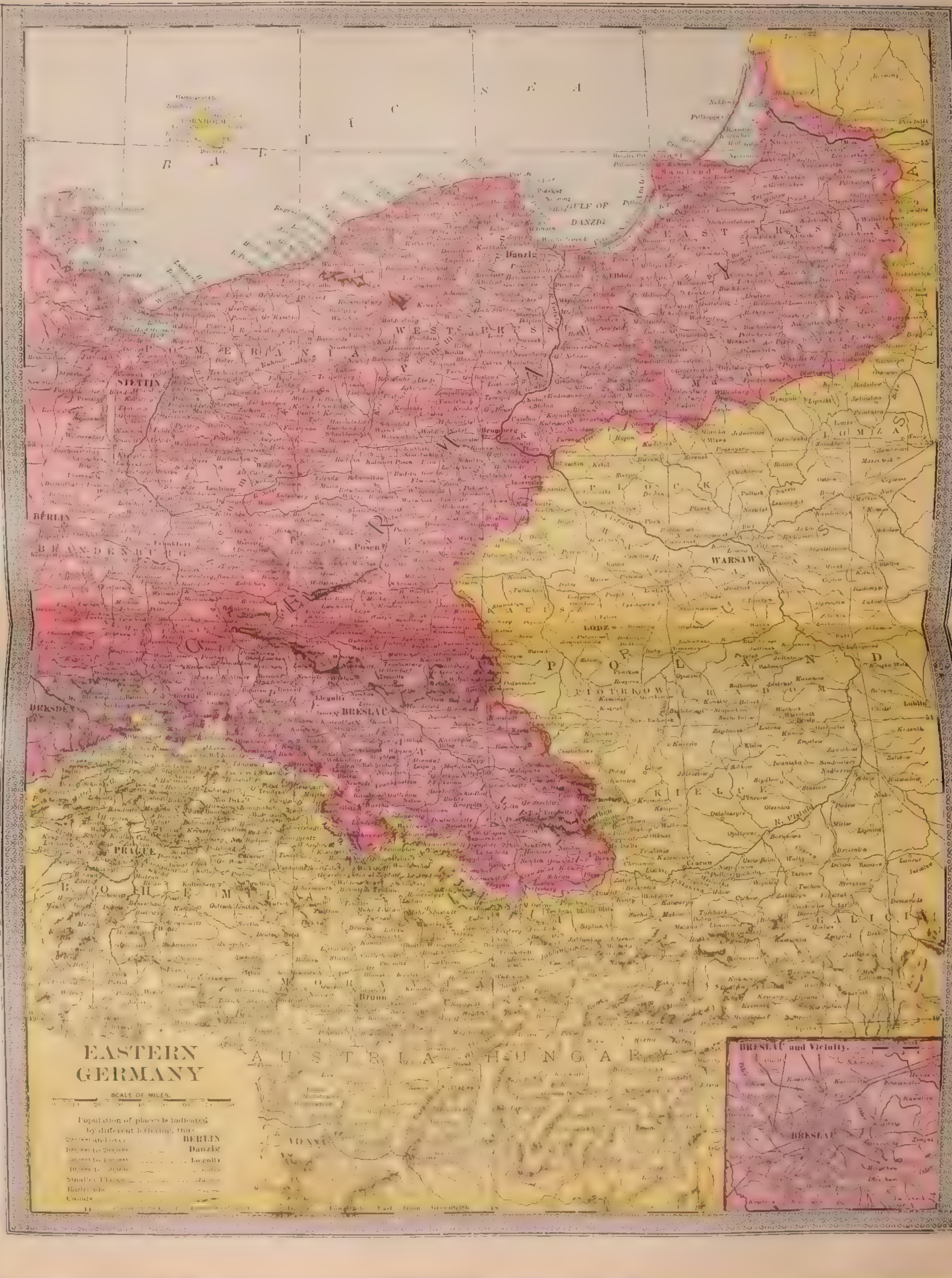
Commerce.— The territory of the customs union known as the Zollverein now comprises the whole empire, with the addition of Luxemburg and the Austrian communes of Jungholz and Mittelberg, and with the exception of the free port of Hamburg, part of Cuxhaven, the free ports of Bremerhaven and Geestemünde, Helgoland, and some southern frontier communes in Baden. The total imports in 1901 were valued at $1,372,413,910, and the exports at $1,094,663,610. The chief imports were cereals, wool, timber, cotton, hides, silk, coal, cattle; and the chief exports were iron goods, drugs, coal, woolens, cottons, sugar, machinery, iron, silks, etc. The imports came mainly from the United States which led all other countries, Great Britain, Austria-Hungary, Russia, France, and Belgium, and the exports were sent chiefly to Great Britain, Austria-Hungary, Russia, United States, Netherlands, Switzerland, and France.

The foreign commerce of Germany is transacted mainly under reciprocal treaties, which have proved a source of much political dissension between native agriculturalists and manufacturers, the former aiming at prohibiting the importation of domestic commodities of foreign origin, and the manufacturers striving to maintain equal or favorable terms of reciprocity.

Manufactures.— The progress of the German manufacturing industry is without parallel among European nations, and is due in large measure to the great advance in technical education. The textile industries give employment to about a million persons, the chief branches being as follows: Cotton in Upper Elsass (Mühlhausen), Saxony (Chemnitz), Rhenish Prussia (München-Gladbach, Elberfeld-Barmen), Würtemberg (Reutlingen), Bavaria (Baireuth, Augsburg), Baden, and Silesia (government of Liegnitz); wool spinning in Rhenish Prussia, Saxony, Würtemberg, and Elsass; woolen cloth in the above districts and also in Lower Lusatia and southeast Brandenburg (Cottbus-Serau district); hosiery in Chemnitz, Glauchau, Plauen, Thuringia, Würtemberg, and Elsass; carpets in Berlin, Barmen, etc.; linen weaving on frontiers of Silesia and Bohemia, Saxony (Zittau), and the Bielefeld district; jute goods in Brunswick, Meissen, etc.; silk in Crefeld, Elberfeld-Barmen, Berlin, Aix-la-Chapelle, Baden, and Lorraine. Three or four hundred thousand persons are employed in the iron and steel manufacture. Its chief seats are: Rhenish Prussia and Westphalia from Düsseldorf to Dortmund, and the Aix-la-Chapelle district; Upper Silesia; and the extreme southern part of the Rhine province between Luxemburg and the Palatinate; but the iron works of Hanover, Saxony, Thuringia, Bavaria, and Würtemberg are also important. The smaller iron industries are chiefly carried on in Solingen, Hagen, Gevelsberg, Remscheid, Aix-la-Chapelle, Iserlohn, Lüdenscheid, Altona, etc. Over 300,000 men are employed in the machinery manufacture, mainly in Rhenish Prussia, Westphalia, Saxony (kingdom and province), Brandenburg (Cottbus to Seraub), Silesia, Bavaria, Elsass, etc. Cassel is the chief place for locomotives, and Berlin, Chemnitz, Dortmund, and Düsseldorf are the chief centres for steam-engines and machine tools. Ship-building is carried on in Bremen, Danzig, Elbing, Flensburg, Hamburg, Kiel, Lübeck, Rostock, Stettin, and Wilhelmshaven, and river steamers are built in Dresden, Mainz, Munich, and elsewhere. Other manufactures of importance are: Plate-glass (Rhenish Prussia, Westphalia, Silesia); bottle-glass (Saxony, Rhenish Prussia, Bavaria, Hanover, Lusatia, etc.); earthenware (Silesia, Hesse-Nassau); porcelain (Meissen, Berlin, Dresden, Silesia, Rhenish Prussia, Thuringia, etc.); bricks, chiefly in the north; tanning (especially Mainz, Worms, Kirn, Malmedy, Saxony); boots, and shoes (Pirmasenz, Mainz, Balingen, Offenbach, Thuringia, Saxony, Silesia); gloves (Saxony, Würtemberg, Berlin); fur goods (Leipsic); gold and silver, brass, and bronze wares; toys (especially Nuremberg and Thuringia); optical, medical, mathematical, musical, and other apparatus and instruments; telegraphic and electrical apparatus and machinery (Aix-la-Chapelle, Berlin, Breslau, Chemnitz, etc.); calcium carbide and acetylene; drugs; aniline and alizarine dyes; soap and candles; beet sugar (Saxony, Silesia, Rhenish Prussia, Thuringia; trade centres are Magdeburg, Breslau, Berlin, Cologne); brewing (best in Bavaria, Berlin, Dresden); distilling; furniture, cigars (Saxony); lithographic stones (Solnhofen); etc. The cottage system of in-



WESTERN GERMANY
SCALE OF MILES
0 10 20 30 40 50 60 70 80
Population of places is indicated by different lettering, thus
200,000 and over BERLIN
100,000 to 200,000 Bremen
50,000 to 100,000 Spandau
10,000 to 50,000 Sulzbach
Smaller Places Zähringen
Railroads
Canals
BALTIC SEA
DENMARK
WEST AND EAST FRISIAN ISLANDS
ZUIDER ZEE
Heligoland
Kiel Bay
HAMBURG
MECKLENBURG
POMERANIA
STETTIN
BERLIN
Bremen
OLDENBURG
HANOVER
Brunswick
MAGDEBURG
WESTPHALIA
Dortmund
DUSSELDORF
COLOGNE
Aix la Chapelle
RHENISH PRUSSIA
HESSE NASSAU
FRANKFURT
LEIPZIG
DRESDEN
CHEMNITZ
THURINGIAN STATES
BELGIUM
LORRAINE
Strassburg
Mannheim
NURNBERG
BAVARIA
Stuttgart
WURTEMBERG
MUNCHEN
Basel
ZURICH
AUSTRIA
PRAGUE
BOHEMIA
HUNGARY
TYROL
BERLIN and Vicinity


EASTERN GERMANY
SCALE OF MILES
Population of places is indicated by different lettering, thus:
BERLIN
Danzig
BRESLAU and Vicinity
BRESLAU
BALTIC SEA
GULF OF DANZIG
EAST PRUSSIA
WEST PRUSSIA
POMERANIA
BRANDENBURG
POSEN
STETTIN
BERLIN
DRESDEN
PRAGUE
BOHEMIA
WARSAW
LODZ
POLAND
KIELCE
GALICIA
AUSTRIA HUNGARY
VIENNA
Brunn
Bromberg
Danzig

dustry is gradually being displaced by the factories, but it is still common in some branches.

Shipping and Navigation.— The mercantile marine is steadily increasing in numbers, and now includes the fastest transatlantic steamers. On 1 Jan. 1901 it comprised 3,883 vessels (registered tonnage, 1,941,645), of which 1,390 (registered tonnage, 1,347,875) were steamers. The principal seaports of Germany are Hamburg, Bremen, Lübeck, Stettin, Kiel, Danzig, and Königsberg. In addition to the figures given, are 22,564 vessels engaged in coasting trade and inland navigation, 21,945 of which are registered with a total of 3,370,447 tons.

Railways.— The length of railway controlled by the Union of German Railways in 1900 was 55,963 miles, of which 19,693 miles were in Austria-Hungary, Netherlands, Luxemburg, Rumania, etc. The total railway mileage of Germany in 1900 was 36,270, of which Prussia had 26,672, Bavaria 4,192, Saxony 1,878, Baden 1,210, Würtemberg 1,163, and Elsass 1,155. Of the total 28,547 miles were state lines.

Canals.— The excellent river system has been supplemented, especially in recent times, by the construction of numerous canals. Throughout the empire the rivers are naturally navigable for 5,774 miles; there are 1,458 miles of canalized rivers, and 1,519 miles of canals. One of the most modern and most important canals is the Kaiser Wilhelm Canal (q.v.) connecting the North Sea and the Baltic, which was opened for traffic 19 June 1895.

Posts, Telegraphs, and Telephones.— With the exception of Bavaria and Würtemberg, the postal and telegraphic services of Germany are united under an imperial postal district. Throughout the German empire in 1901 17,049 towns had telephonic communication.

Money, Weights, and Measures.— By the law of 4 Dec. 1871 a uniform gold standard was introduced for the whole German empire, it being decreed that out of one pound of fine gold 139½ pieces of an imperial gold coin should be struck, the tenth part of which should be called a mark, and divided into 100 pfennige; that an imperial gold coin of the value of 20 marks should also be struck at the rate of 69¾ to 1 pound of fine gold; and that these coins should be made of an alloy containing 900 parts of gold and 100 parts of copper. The same law ordered the adoption of the mark as the general unit of the German coinage, commencing 1 Jan. 1875. By the supplementary law of 6 May 1873 it was enacted that two-mark and five-mark pieces should also be issued, the former in silver and the latter partly in gold and partly in silver. The 10-mark piece (*krone*) and 20-mark piece (*doppelkrone*) are nearly equal in value to the English half-sovereign and sovereign respectively. The old silver thaler (=3 marks) is still legal tender. A mark is equal to 23 cents in United States gold.

Since 1 Jan. 1872 the French metrical system of weights and measures has been in force throughout the German empire. It had previously been adopted by a law of the diet of the North German Confederation, and under the constitution of the new German empire it was arranged that the new system of weights and measures should be introduced into the south German states according to the terms of separate treaties previously concluded by them with the North German Confederation. As the values of the different units of the metric system are given in the article WEIGHTS AND MEASURES, it will be sufficient here to give the German names of the various denominations of that system:

Measures of Length —

Das Millimeter or Der Strich	= the Fr.	Millimètre.
" Centimeter or " Neuzoll	= "	Centimètre.
" Decimeter	= "	Décimètre.
" Meter or Der Stab	= "	Mètre.
" Dekameter or Die Kette	= "	Decamètre.
" Kilometer	= "	Kilomètre.

The new German mile is equal to 7,500 metres.

Measures of Surface —

Das Quadratmeter or Der Quadratstab	= the Fr.	sq. Mètre.
" Ar	= "	Are.
" Hektar	= "	Hectare.

The unit of the measures of capacity is *das Kubikmeter* or *der Kubikstab* = the French *stère.*

In liquid measure the following terms are used:

Das Liter or Die Kanne	= the Fr.	Litre.
" Hektoliter or Das Fass	= "	Hectolitre.

A measure equal to half a liter is called a *Schoppen,* and one equal to 50 liters a *Scheffel.*

Measures of Weight —

Das Milligramm	= the Fr.	Milligramme.
" Decigramm	= "	Centigramme.
" Centigramm	= "	Décigramme.
" Gramm	= "	Gramme.
" Dekagramm	= "	Décagramme.
" Kilogramm	= "	Kilogramme.

Half a kilogramm is one *Pfund;* 50 kilogramms, or 100 *Pfund,* make one *Centner;* and 1,000 kilogramms one *Tonne.*

Banking.— The *Reichsbank* or Imperial Bank founded by the *Reichstag* in 1875 is the depository of the imperial treasury, the leading bank of issue, and of imperial banking operations. At its establishment it shared the authority to issue bank-notes with 31 other banks, which number by 1900 had diminished to 7, the Bank of Baden, Bavarian Bank of Issue, the Bank of Brunswick, Bank of Frankfort, Bank of Saxony, South German Bank, and Würtemberg Bank of Issue. The total business of the Imperial Bank in 1900 was $44,982,000,000, its loans on securities alone in that year amounting to $209,400,000. One of its most important branches is the clearing house department. There are clearing houses also in the most important cities, numerous private banks, people's banks, agricultural mortgage banks, and about 150 joint stock banking companies with a total capital in 1900 of over $428,400,000.

Constitution and Government.— The constitution of the German empire is based on the decree of April 16, 1871. The presidency of the empire is the privilege of the king of Prussia, to whom belongs the hereditary title of German Emperor. The legislative authority is vested in the Bundesrath, or Federal Council, and the Reichstag, or Imperial Diet. The prerogatives of the emperor are to represent the empire in its relation to other states, to declare war and conclude peace in the name of the empire, to contract alliances and conclude treaties with foreign states, to accredit and receive ambassa-

dors. The assent of the Bundesrath is, however, necessary to a declaration of war, unless the imperial territory be invaded, or its coasts attacked. The emperor has also the supreme command of the army and navy, summons, opens, prorogues, and concludes the Bundesrath and Reichstag, appoints and dismisses officials of the empire, and superintends the consulate.

The Bundesrath consists of 58 representatives of the members of the empire. Of these 17 are returned by Prussia, 6 by Bavaria, 4 each by Saxony and Würtemberg, 3 each by Baden and Hesse, 2 each by Mecklenburg-Schwerin and Brunswick, and 1 each by Saxe-Weimar, Mecklenburg-Strelitz, Oldenburg, Saxe-Meiningen, Saxe-Altenburg, Saxe-Coburg-Gotha, Anhalt, Schwarzburg-Rudolstadt, Schwarzburg-Sondershausen, Waldeck, Reuss-Greiz, Reuss-Schleiz, Schaumburg-Lippe, Lippe-Detmold, Lübeck, Bremen, and Hamburg. Alsace-Lorraine (Elsass-Lothringen) is represented in the Bundesrath by four commissioners without votes. Every year or every session standing committtees of the Bundesrath are appointed by the members from their own number: (1) for the army and fortifications; (2) for the navy; (3) for the customs and other imposts; (4) for trade; (5) for railways, posts, and telegraphs; (6) for justice; (7) for finance; (8) for foreign affairs; and (9) for the affairs of Alsace-Lorraine.

The Reichstag is elected by secret voting in all the states, every German above 25 years of age having a right to vote in the state in which he resides. Members of the army and navy cannot exercise their right of voting while their period of service lasts. Anyone may be returned to the Reichstag who has the right of voting and who has belonged for at least a year to one of the states. As a rule, one member is returned to the Reichstag for every 100,000 of the inhabitants of each state, but every member of the empire sends at least one deputy, even though its population is under that number. In 1902 the Reichstag consisted of 397 members, namely: 236 from Prussia and Lauenburg, 48 from Bavaria, 23 from Saxony, 17 from Würtemberg, 15 from Alsace-Lorraine, 14 from Baden, 9 from Hesse, 6 from Mecklenburg-Schwerin, 3 each from Saxe-Weimar, Oldenburg, Brunswick, and Hamburg, 2 each from Saxe-Meiningen, Saxe-Coburg-Gotha, and Anhalt, and 1 each from the other states. Proposals of laws are laid before the Reichstag by members of the Bundesrath, or by commissaries appointed by it. Every member of the Bundesrath has the right of appearing in the Reichstag, and has a right to be heard there at any time to represent the view of the government. No one can at the same time be a member of the Bundesrath and the Reichstag. The Reichstag lasts for five years. To dissolve it within that period a decree of the Bundesrath and the assent of the emperor are necessary. In case of a dissolution new elections must take place within 60 days, and the new Reichstag must meet within 90 days. To render an imperial law (*Reichsgesetz*) valid there must be a majority of votes in its favor both in the Bundesrath and in the Reichstag, and nothing else is required. Changes in the constitution may be effected in the same way. Disputes between two or more states of the empire, in so far as the common law courts are incompetent to deal with them, may be settled by the Bundesrath on an appeal being made to that body by either of the parties to the dispute.

The empire has the sole right of legislating on all matters connected with the army and navy, the finances of the empire, commerce, posts and telegraphs (except in Bavaria and Würtemberg), railways in so far as they are deemed necessary for the defense of the country, and proposed modifications of the constitution of the empire. Certain other matters are left largely to the management of the individual states.

Finance.— The total revenue and expenditure of the empire for 1902 were estimated to balance at $540,340,764. The chief sources of revenue are the customs, excise duties on tobacco, sugar, salt, and spirits in all the states, an excise duty on beer except in Bavaria, Würtemberg, Baden, and Elsass, stamps, posts, and telegraphs except in Bavaria and Würtemberg, railways, and the *Matricular Beiträge* paid by the federated states to the imperial treasury in proportion to population, but with additions in the case of those states which administer their own posts, telegraphs, and beer duties. The bonded debt of the empire in 1900 was $528,655,000, against which are to be set the invalid fund of about $98,000,000, and the war treasure fund of $30,000,000. When the German empire had been in existence six years its debt amounted to the insignificant sum of 16,300,000 marks. In 1888, when the old emperor died, it was only 721,000,000 — not very large for a nation of importance. Two thirds of the present debt has been used for naval and military purposes, the rest for civil administration, etc. In 1886 the naval and military estimates amounted to 497,000,000 marks. In the following year they rose to 632,000,000 marks. In 1903 the estimates rose to 972,000,000 marks. From 1897 to 1903 the yearly interests to be paid for loans invested in the army and navy rose from 61,000,000 to 83,000,000 marks.

Army and Navy.— Service in the army or navy is obligatory on every German capable of bearing arms from the age of 17 to that of 45. Within this period seven years must be passed in the standing army or in the fleet (generally the years between 20 and 28) two of them in active service (three for cavalry and horse artillery). The remainder of the seven years are passed in the reserve. The next five years are passed in the first class or "ban" of the *Landwehr* or *Seewehr* (land or sea defensive forces); service continuing in the second class or ban up to the age of 39. Of young men becoming liable to service every year, only a certain number chosen by lot join the regular army; the remainder enter the *Ersatztruppen* or depot reserve, in which service lasts for 12 years. The *Landsturm* consists of all from 17 to 45 who are not otherwise in service; being divided into two bans or sections; the first comprising men from 17 to 39, the second those from 39 to 45. This force is only called on for active service in case of an invasion of the country. Young men above 17 years of age, who are able to pass an examination on general subjects, and who volunteer for active service

THE GERMAN EMPEROR AND HIS FAMILY.

in the army, and agree to equip and maintain themselves during active service, are admitted into the reserve after one year's service. This privilege is also granted to teachers in primary schools, and Roman Catholic priests ordained before a certain age are exempt from active service and drill altogether.

Organization and Strength of the Army.— The German army consists of 23 army corps, of which three are furnished by Bavaria, two by Saxony, one by Würtemberg, and the remaining 17 by Prussia and the other states. The Bavarian corps are numbered separately, and in time of peace form a separate army under the king of Bavaria. The Prussian Guard Corps, with headquarters at Berlin, is recruited from all Prussia, but the others have districts allotted to them. The corps are grouped into five inspections, each comprising from three to five corps. The following is a list of the headquarters of the various corps arranged in inspection groups, the first mentioned town in each being the headquarters of the inspection: Berlin — Königsberg, Stettin, Altona, Hanover, Danzig; Dresden — Posen, Breslau, Dresden, Leipsic; Hanover — Münster, Coblentz, Cassel, Stuttgart, Frankfort-on-the-Main; Munich — Berlin, Magdeburg, Munich, Würzburg, Nuremberg; Carlsruhe — Carlsruhe, Strasburg, Metz. Each corps has ordinarily two divisions, each comprising infantry, cavalry, and field artillery. Each army corps district is divided into two divisional districts, and from four to six brigade districts. Each brigade district is subdivided into from one to six *Landwehr* districts, and the total number of these district commands is 293. In case of war the army corps are brought up to their full complement of men by drawing on the reserve and the *Landwehr.*

The following table shows the total strength of the German army on the peace footing in 1900:

	Officers	Rank and File
Infantry	13,314	335,797
Cavalry	2,406	56,819
Field Artillery	2,980	52,622
Foot Artillery	872	18,730
Pioneers	571	12,504
Train	322	6,213
Railway, Telegraph, and Balloon Service	237	5,175
Others	3,142	3,276
Total	23,844	491,136

Under the Army Act of 1899 the peace effective was to be gradually increased, and in 1903 reached 605,978; as an interesting comparison, in 1872 it was 350,000. The war strength is now estimated at about 3,000,000 men.

Strength of the Navy.— The German war fleet has been greatly increased in recent years and the rate of increase is likely to be maintained for some time. By the law of 14 June 1900 the effective strength (excluding torpedo boats and some others) has been fixed as follows: A fighting fleet comprising 2 admiral's flag ships and 4 squadrons, each of 8 ships of the line, 8 large and 24 small cruisers, a fleet for service abroad of 3 large and 10 small cruisers; a reserve of 4 ships of the line, 3 large and 4 small cruisers. The present strength of the imperial navy is as follows: 14 battleships of the line, 8 armored coast defense ships, 13 armored gunboats, 11 large cruisers, 25 small cruisers, 5 gunboats, 16 school ships, and 13 others, besides torpedo boats. The personnel of the navy is recruited from the maritime and semi-maritime population of the empire. The total is at present about 30,000 men.

Colonies.— The colonial policy of Germany dates from 1884 since when it has established protectorates over extensive regions in Africa, and over several islands in the Pacific Ocean. Its foreign dependencies have an estimated area of 1,027,820 square miles, and an estimated population of 13,087,000. The African dependencies include Togoland, estimated area 33,700 square miles, population 900,000; Kamerun, area 191,130 square miles, population 3,500,000; German East Africa, area 384,180 square miles, population 8,000,000; German Southwest Africa, area 322,-450 square miles, population 200,000. Total of African dependencies — acquired between 1884 and 1890 — 931,460 square miles, population 12,600,000. The Pacific dependencies acquired between 1884 and 1899 comprise under German New Guinea, Kaiser Wilhelm's Land, area 70,000 square miles, population 110,000; in addition there are the Bismarck archipelago, area 20,000 square miles, population 188,000; Caroline Islands and Palan Islands, 560 square miles, population 40,000; Marianne Islands, 250 square miles, population 2,000; Solomon Islands, 4,200 square miles, population 45,000; Samoan Islands, 1,000 square miles, population 29,100; and Marshall Islands, area 150 square miles, population 13,000. Total of Pacific possessions 96,160 square miles, population 427,000. In 1897 Germany seized Kiao-Chau on the east coast of the Chinese province of Shan-tung, and in 1898 declared a protectorate over the town, harbor, and district, which has an area of 200 square miles, and an estimated population of 60,000. With the exception of the Marshall Islands, which are administered by an imperial commissioner, the colonies are under the direct rule of imperial governors with almost autocratic powers. The colonies have not yet proved self-supporting and are assisted by government grants which in 1901 amounted to about $7,400,000.

Ethnology.— The Germans are descendants of Teutons, Vandals, Franks, Allemanni, and the numerous tribes which figure in Roman history as dwelling within the limits of Germania (see paragraph on *History*). From language and other indications they are supposed to have migrated in prehistoric times from Upper Asia, passing by the Caucasus and the north of the Caspian and Euxine seas to Europe. There is no mention of this migration in the national legends, and the people considered themselves as autochthones, and were thus regarded by the Romans. They are usually classified into Low or northern Germans, and High or southern Germans. Within the boundaries where they constitute the compact mass of the population and include the German-speaking Dutch and Flemings, their numbers are estimated at 56,000,000. The German empire also includes over 4,000,000 natives of foreign extraction, comprising Poles, an antagonistic element numbering about 3,000,000 dwelling chiefly in Posen

and Silesia, northeast Prussia; Danes, found in Schleswig; Wends in Brandenburg, Silesia, and Saxony; Czechs in Silesia; Lithuanians in East Prussia; French in Alsace-Lorraine; and about 570,000 Jews distributed through the empire. The dividing line between Low and High Germans may be drawn from lat. 50° 30′ N. in western Germany to lat. 52° 30′ N. on the eastern frontier. In physical development the Germans are superior to either the Latin or Slavic race, while surpassed in agility by the former and in power of endurance by the latter. Their frame and their muscular development are strong, almost heavy. Among the lower classes of the rural and laboring population, stoutness and strength often approach to clumsiness, which is heightened sometimes by a servile bearing and a certain uneasiness and want of self-reliance. The northerners generally are taller and of better shaped features and limbs than the southerners. The blonde complexion prevails only in the north; in central and southern Germany light or dark brown is more frequently found. The prominent features of the German national character are honesty, faithfulness, valor, thoughtfulness perseverance, and industry. The German is patient, conservative, and inoffensive; he favors a moderate enjoyment of the pleasures of social life, but sometimes, or rather in some portions of Germany, this is carried to excess and the complaint has been heard that popular movements in favor of liberty have been drowned in the social cup. Of a scientific turn of mind, the Germans have largely promoted the progress of human knowledge. There is scarcely a branch of science in which Germans have not excelled. In the fine arts also they occupy one of the highest ranks among nations. The German artisan is highly valued for his dexterity and steadiness.

Sociology.— The element of a strong national feeling was long lacking in the German character, and of no other country in Europe is it so true as it is of Germany, that it is the product of conscious will. German nationality, German life, German material civilization, have been developed by a succession of great men who were at first electors of Brandenburg, then kings of Prussia, and finally emperors of Germany. Other nations have slowly crystallized; this one was welded, like a sword. The Anglo-Saxon race believe in a nation which unfolds its own genius, attains to liberty, and governs itself by constitutional forms. The Latin race likes an orderly, logical, ready-made system. But here is a powerful nation which is a historical yet artificial creation, the work of a house of hero rulers of the Carlyle type. Paternalism flourishes in Germany because Germany is the child of paternalism. Its history has not been, as England's, the history of a people struggling against the royal prerogative to secure their freedom and establish their political institutions, but of a people led forward by strong rulers to a foreseen end. Not the rights of the individual, but the good of the state and the bonds of duty, have been the vital forces of progress. That is why the emperor can talk to his subjects as he does of obedience, loyalty, discipline, the greatness of his ancestors, and what he himself proposes to do, without making himself ridiculous to them.

The corner-stone of the Hohenzollern nation-building has been military power. "The world does not rest more securely on the shoulders of Atlas," said Frederick the Great, "than the Prussian state on the shoulders of the army." By the army the elector of Brandenburg, Frederick III., won the right to crown himself Frederick I., king of Prussia, owing no allegiance to the house of Hapsburg. By the army his grandson, Frederick the Great, raised his little kingdom to the rank of a great European power. By the army Emperor William I. brought about national unity. By army and navy Emperor William II. means to make real his conception of a world-power.

But Germany is not great by its army alone. In peace as in war, Prussia has developed efficiency. Its rulers have taken care to bring about conditions favorable to economic and intellectual progress. In these respects also they have planned and promoted what has come to pass. Government has meant to them the intelligent direction of the national life. "The strength of North Germany," said Arminius long ago, "lay in this, that the idea of science governed every department of human activity there." The same is true to-day. See GERMAN ART; GERMAN LANGUAGE AND LITERATURE.

Population.— Statistical estimates for the German empire place the population on 1 July 1903 at 58,549,000, against 57,708,000 and 56,862,000 on 1 July 1902 and 1901, respectively.

From these figures it appears that the population has increased 841,000, or 1.46 per cent in 1903, while the increase of 1902 over 1901 was 846,000, or 1.49 per cent. The census of 1 Dec. 1900 showed a population of 56,367,178. Thus, according to official estimates, the increase in two and one half years is 2,180,000. In the last 10 years the population has increased 7,800,000, in the last 20 years 12,500,000, and since the formation of the German empire 17,500,000.

The excess of female births in proportion to male is 6 per cent, and the number of women exceeds the number of men by 3.2 per cent. The census of 1900 returned 27,731,067 men and 28,613,947 women or an excess of 882,430 women.

Emigration.— The German as an individual is in many instances more favorably inclined toward other countries than his own. This probably results from an abstract idealism with which many Germans seem imbued. Among the great number of emigrants from Germany to other continents, there are thousands with whom the motive for voluntary expatriation is not social or individual misfortune, but merely a visionary longing after an ideal state of society. The United States receives the bulk of German emigration. It is estimated that during the 19th century more than 6,000,000 emigrants left Germany, of which number the United States received 90 per cent, the rest being divided among South American states, Australia, Africa, and Asia. In recent years emigration has greatly decreased, due to improved social and economic conditions at home. See GERMANS IN THE UNITED STATES; GERMANY, MODERN.

Education.— Throughout the empire education is general and compulsory, the laws providing for the establishment of *Volksschulen* or primary schools in every town and village.

Kindergartens are carried on by private enterprise only. The *Volksschulen* are supported by the local rates, and parents are compelled to send their children, from the age of 6 to 14, to these or other schools, such as the *Bürgerschulen* and *Höhere Bürgerschulen*, middle-class schools of the towns which rank above the normal or primary schools. *Fortbildungsschulen*, or continuation schools, are provided for children of the working classes, and are open on evenings and Sundays for those who wish to pursue their studies; they provide for two- and three-year courses and give technical instruction. Secondary and advanced education is conducted along the lines of social distinctions, and the schools of this grade are constituted with regard to the business or professional careers which it is intended the pupils should pursue. They comprise the *Oberrealschulen* and *Realschulen*, in which the classics are displaced in favor of modern languages; the *Realgymnasia*, in which Latin but not Greek is taught, more attention being devoted to modern subjects; *Gymnasia*, the most fully developed classical schools, preparing pupils for the learned professions and the universities in a nine-years' course; and *Progymnasia* and *Realprogymnasia*, modifications of the latter two. Higher education for girls is provided by the *Höhere Tochterschulen*. In addition to these there are *Gewerbeschulen*, or technical high schools, polytechnics, schools of agriculture, academies of forestry, schools of mining, of architecture and building, of art and art industry, of music, and 21 universities. With the exception of Münster University, which has faculties of theology and philosophy, all the rest have four faculties: theology, jurisprudence, medicine, and philosophy. In 14 universities the faculties of theology are Protestant; in three, Bonn, Breslau, and Tübingen, Protestant and Roman Catholic; in four, Freiburg, München, Münster, and Würzburg, Roman Catholic.

Religion.— Religious liberty is provided for under the Constitution of the empire, the repeal of the statute of 1872 by the Reichstag, 10 March 1904, having removed the last interdiction which the law placed upon Roman Catholics. According to the census of 1900, 35,231,104, or 62.5 per cent of the population, are Protestants and 20,327,913 or 36.1 per cent, Roman Catholics. The Protestants are divided by their confessions into Reformed and Lutheran bodies. Among Roman Catholics there are two seceding bodies, the German Catholics (q.v.) and the Old Catholics, who repudiated the dogma of the Pope's infallibility in 1871 and now number about 50,000.

Judiciary.— Since 1879 there exists a uniform system of law courts throughout the empire, although the courts are subjected to state and not to imperial control. There are four grades of courts, the lowest court of first instance being the *Amtsgerichte*, presided over by a judge to try petty civil and criminal cases. Above these district courts are the *Landesgerichte*, territorial courts, exercising a revising jurisdiction over the lower courts and also a more extensive original jurisdiction in both civil and criminal cases. In criminal cases five judges sit, four votes being necessary for a conviction. *Schwurgerichte*, jury courts, are also held periodically, consisting of 12 jurors and three judges. The *Oberlandesgericht* is the first court of second instance, divided into civil and criminal senates, the criminal senate consisting of seven judges. Bavaria alone, by special permission, has an *Oberstes Landesgericht* with 22 judges. The *Reichsgericht* is the supreme or imperial court, and sits at Leipsic. It has 92 judges chosen by the Bundesrath and appointed by the emperor; four criminal and six civil senates; and exercises an appellate jurisdiction over all inferior courts, and an original jurisdiction in cases of treason.

Local Government.— With the exception of Mecklenburg, which has a mediæval diet of landholders and city magistrates, all the monarchic states have modernized constitutional governments. The federal principle exists throughout the empire and the rights of the smaller states are guarded by the distribution of votes in the federal council. The free cities (q.v.) of Hamburg and Bremen have mixed governments, while Lübeck is governed by a conservative democracy. The system of local self-government established in Prussia (q.v.) by the cities' ordinance of 1808 is typical throughout the various states, which exercise a general supervision over the enforcement of imperial laws as affecting local affairs.

Poor-relief.— Bavaria and Alsace-Lorraine have independent poor-law legislation; all the other states have adopted the settlement law passed by the Reichstag in 1870. Settlement for purposes of poor-relief is obtained by a residence of two years in a commune, each commune providing for its own poor. Anyone entitled to poor-relief may obtain it from a commune in which he may happen to be, that commune recovering expenses from the settlement commune of the applicant. *Landarme* or applicants without settlements are provided for by the government of their native state.

History.— The territory to which the ancients gave the name of Germany was much larger than the modern territory of the same name. It comprised to the north Denmark, Sweden, and Norway, and on the south Pliny makes it extend as far as the Alps, but up till the time of Cæsar the southern boundary was the Danube. The boundary on the east with Sarmatia and Dacia is not exactly defined, and on the west the Rhine was only a nominal or formal boundary. The Germans had extended beyond the Rhine in the time of Cæsar, who gives this boundary. The Belgæ and the Treviri, who occupied Alsace, were at least mixed races; and Ptolemy gives the names Germania Superior and Germania Inferior to two divisions of Belgica extending along the west bank of the Rhine, from the sea to the Sequanian territory, near Basel. These divisions are also mentioned by Tacitus as forming two of the six divisions of Gaul. Germany east of the Rhine was called Germania Magna or Barbara. Pliny enumerates 68 tribes and 94 towns in Germany.

Germany, especially the southern part, was covered in the time of the Romans by extensive marshes and forests which were inhabited by the elk, the urus, the bear, the wolf, the boar, the wild cat, and the deer. The population was large, however, particularly in the north and east, the chief indication of which is the num-

ber of the armies, or rather of the armed tribes which these districts from time to time sent out, and by which at length the Roman empire was overwhelmed.

Tacitus classifies the German nations into three groups, Ingævones, Herminones, and Istævones. These divisions are said to be named from the three sons of Mannus. The first inhabited the shores of the ocean, the second the interior, the third the south and east, but their limits are not defined.

The first distinct appearance of the Germans on the stage of classical history occurs 113 B.C., when the Teutons, a German people, appeared along with the Cimbri, supposed to be a Celtic one, on the frontiers of Gaul, defeated the Romans in several battles, and after the Cimbri had invaded Spain, were joined by the Ambrones, a people of Sarmatia, and continued to ravage Gaul. They were defeated by Marius near Aix (Aquæ Sextiæ) 102 B.C., when 100,000 are said to have been slain and 80,000 or 90,000 made prisoners. A small number who escaped, about 6,000, are supposed to have settled in the north of Gaul and become the ancestors of the Ædui. In 58 B.C. Ariovistus, king of the Suevi, who had crossed the Rhine and with an army of 120,000 Germans had subdued the greater part of eastern Gaul, was defeated by Cæsar and forced to recross that river. In 55 and 54 B.C. Cæsar himself crossed the Rhine, but effected no permanent settlement. He acquired an accurate knowledge only of the tribes nearest the Rhine, the Ubii, Sicambri or Sygambri, Usipetes, and Tencteri. He enlisted Germans in his army, both against the Gauls and against Pompey. Of the Germans with whom he did not become acquainted, he was informed that they lived more by hunting and pasture than by agriculture, held their fields in common, and prevented the approach of foreign nations by devastating their borders.

The civil wars diverted the attention of the Romans from Germany. The Confederacy of the Sicambri made inroads into Gaul with impunity, and Agrippa transferred the Ubii, who were hard pressed by the Suevi, to the west side of the Rhine. But the Sicambri having defeated Lollius, the legate of Augustus (16 B.C.), the emperor himself hastened to the Rhine, erected fortifications along the bank of this river to oppose the progress of the enemy, and gave his stepson Drusus the chief command against them. This great general was victorious in several expeditions and advanced as far as the Elbe. Tiberius after him held the chief command on the Rhine during two years and exercised more cunning than force against the Germans. He induced them to enter the Roman service. The bodyguard of Augustus was composed of Germans and the Cheruscan Arminius was raised to the dignity of knight. Tiberius having received the chief command a second time (4 A.D.), advanced to the Elbe. Germany had now been subdued by the successes of Drusus and Tiberius from the Rhine to the Weser, and Augustus had determined to introduce into it the regular administration of a Roman province. For this purpose he selected P. Quintilius Varus, who in accordance with his instructions proceeded to introduce the Roman rule; but these orders were either premature or were rashly executed. The Germans revolted under the leadership of Arminius, the Cheruscan already referred to, who had acquired a knowledge of military tactics in Rome. Besides the Cherusci, the Marsi, the Chatti, and the Bructeri joined the revolt. Arminius concocted his plans with a subtlety which speaks volumes for the vaunted fidelity of the Germans. By his recommendations the Germans obeyed all the orders of Varus, who had taken up his quarters on the banks of the Weser. Arminius and the other chiefs visited his camp on friendly terms.

Varus was induced by their recommendations to divide his troops. In the meantime a distant tribe was induced to revolt. Varus marched against them while his pretended allies went to collect their forces. He had entered the Teutoberg Forest without suspicion of danger with three legions, when he was suddenly attacked by the combined forces of the Germans, and after three days' fighting his army was almost completely destroyed (A.D. 9). He himself put an end to his life. The fortress of Aliso, erected by Drusus, to which a few had escaped, was afterward taken and destroyed and the Romans lost all their possessions east of the Rhine. The Cherusci now for a time became the principal nation of Germany. Germanicus after suppressing a revolt among the legions of the Rhine led them against the Germans and in a succession of campaigns avenged the defeat of Varus by ravaging the country of the Marsi and the Chatti and defeating the Cherusci under Arminius (A.D. 14–16), but he failed to recover the Roman ascendency in Western Germany. The wars which broke out among the Germans themselves, however, enabled the Romans to establish themselves in the southwest. Maroboduus, who had been sent to Rome as a hostage, and educated at the court of Augustus, at the head of some Suevian tribes, had subdued or expelled the Boii, who inhabited Bohemia and part of Moravia, established the Marcomannic kingdom, and organized the neighboring tribes into a league for defense against the Romans which became known as the Marcomannic confederacy. Augustus despatched Tiberius against Maroboduus, but the revolt of the Cis-Danubian provinces compelled Tiberius to make peace with him. Afterward the Marcomannic confederacy excited the jealousy of the Cherusci, and a war ensued which ended (A.D. 17) in the defeat of the Marcomanni. Maroboduus besought the assistance of Rome, and Drusus was sent to mediate a peace; but in A.D. 19 on some new offense Drusus was preparing to invade the country of the Marcomanni when Catualda, a chief of the Gothones whom Maroboduus had exiled, invaded and conquered it. Catualda was himself overcome and expelled by the Hermunduri. After this the Marcomanni were for a time dependent on the Romans, though with a king of their own.

The Romans had during this period, or from about A.D. 16, commenced to establish themselves on the southwest between the Upper Rhine and the Upper Danube. Here they formed a province called the Agri Decumates, peopled by Gauls, Germans, and Romans and subject to tribute. It was ultimately included in Rhætia and protected by a wall dividing it from the free Germans, but this proved an ineffectual protection against the incessant attacks to which it was subject during the decline

of the empire. The Cherusci after the loss of their great leader Arminius, A.D. 21, fell from their high rank among the German nations. Weakened by internal dissensions they were conquered by the Chatti, who now rose into importance, and sank into an insignificant tribe to the south of the Hercynian Forest. They appear again in the Frankish confederacy in the 4th century. The Chatti made repeated incursions across the Rhine which it required the force of more than one Roman emperor to restrain. They were also absorbed in the Frankish confederacy, as well as a colony of the Sicambri which Tiberius had transplanted to Gaul, and settled between the banks of the Lower Meuse and the Rhine. The Frisians, who had early entered the Roman alliance and remained faithful to it till A.D. 28, rose and expelled the Romans in consequence of the oppression of Olennius, the Roman governor. Corbula attempted to subdue them A.D. 47, but was recalled before he had achieved a decisive success.

The Batavi, a colony of the Chatti who left their homes in consequence of internal broils and occupied an island at the mouth of the Rhine, became allies of the Romans whom they furnished with soldiers, particularly with cavalry. They revolted A.D. 69 in the reign of Vitellius, and were with difficulty subdued. Domitian (A.D. 84) undertook an expedition against the Chatti and constructed a frontier wall between the free Germans and those subject to Rome. The Marcomanni had in the meantime been extending their dominion and had come into contact with the Romans on the Danube. Domitian asked their assistance according to treaty, in his war with the Dacians, and on their refusal went to war with them. Being defeated by the Marcomanni he was obliged to make a humiliating peace with Decebalus, king of Dacia.

As the aggressive force of the empire abated it continued to be more and more subject to the incursions of the Germans in Gaul, in Rhætia, in Noricum, and Pannonia. The Marcomanni were kept in check by Trajan and Hadrian, but being pressed by the migrations of other German tribes, they invaded the Roman provinces in 166, and commenced the Marcomannian war which was continued with a short interval till 188, when Commodus purchased peace of them. After this time their inroads increased in boldness and in the reign of Aurelian they penetrated into Italy and reached as far as Ancona. From this time they began to decline in importance, and the last mention of them is among the hordes of Attila. Two new combinations of German tribes — the Alemanni and the Franks — began soon after the termination of the Marcomannian war to threaten the Roman dominion on the west banks of the Rhine, and these incursions went on increasing till by the end of the 5th century the Germans had conquered Gaul, Italy, Spain, and part of Africa, having established a new kingdom on the ruins of Carthage. This great movement is called the migration of the nations. The Saxons, Frisians, and Angles toward the close of this period began their invasions of Britain. After this migration Germany itself continued in a divided state till it was conquered by Charlemagne. From the establishment of the Frankish kingdom of Clovis till the end of the Carlovingian dynasty the most important events of German history will be found in connection with the history of France (q.v.).

The deposition of Charles the Fat in 887 separated Germany from France; and Arnulf, an illegitimate descendant of Charlemagne, acceded to the crown of the former country. He was crowned emperor in 896 after a victory over Berengarius, Duke of Friuli. He died in 899, and was succeeded by his infant son Louis, who was proclaimed King of Lorraine in 900, assumed the title of emperor in 908, and as such is designated Louis IV. He died in 911, and with him the German branch of the Carlovingian dynasty became extinct. The German nations in their general assembly or diet chose Conrad, Count or Duke of Franconia, as his successor. He died in December 918 of a wound received in battle with the Huns. In 919 Henry the Fowler, Duke of Saxony, was elected. He invaded and annexed Lorraine which was now as afterward disputed between France and Germany. He extended the empire by successful wars against surrounding and less civilized peoples — the Huns, Vandals, Danes, and Bohemians — and he defeated the Hungarians, to whose incursions Germany was at this epoch subject, at Merseburg in 934. He was succeeded by his son Otto the Great in 936, who completed the conquest of Bohemia (950), invaded Lombardy, and was proclaimed King of Italy (951); after deposing Berengarius a second time he received the Italian crown at Milan (961); and revived the empire of Charlemagne and received the crown of the Holy Roman empire from the Pope 2 Feb. 962. He died in 973 and was succeeded by his son Otto II., who had been crowned emperor by the Pope in his father's lifetime. In 976 Otto deprived Henry of Bavaria, with whom he had been engaged in war, of his duchy. He also had a successful war with Lothaire, king of France, for the possession of Lorraine. He attempted the conquest of Calabria in 981, and held a diet at Verona in 983, at which his son Otto III. was declared his successor. He died in Rome the same year. Otto III., who was in his fourth year when he succeeded his father, was crowned by the Pope in 996. He held a diet at Rome in the same year and another at Aix-la-Chapelle in 1000. In January 1001 he defeated the Saracens in Italy. He died in 1002. Henry II., Duke of Bavaria, surnamed the Saint, the hereditary heir of the Saxon line, succeeded after a contest with Herman, Duke of Suabia, a rival claimant of the crown. He had frequent wars in Poland and Italy, and in 1022 he presided at the Council of Seligenstadt. He died in 1024, and was canonized by Pope Eugenius II. in 1152. With him ends the Saxon line of emperors.

Conrad II., surnamed the Salic, a Franconian nobleman and a descendant in the female line of Otto the Great, was chosen to succeed him. In 1033 he succeeded to the kingdom of Arles, which provoked a war of succession with Eudes, Count of Champagne. He also spent several years in Italian wars. He died in 1039. He was succeeded by his son Henry III., who as on former occasions had been chosen in his lifetime. He exercised

more despotic authority in Germany than any of his predecessors, setting aside the fundamental laws of the empire established by the diets (q.v.). He died in 1056, and was succeeded by his son Henry IV., born in 1050. His long reign was filled with disasters owing to the turbulence of his kingdom and his differences with the Pope, in which his diets frequently sided against him. He was repeatedly excommunicated by popes, and deposed them in his turn. In 1077 Rudolph of Suabia was elected as rival emperor by the party obedient to the Church, or politically opposed to the emperor. Rudolph defeated him several times, but was mortally wounded in battle in 1080. Hermann of Luxemburg, chosen to succeed Rudolph, made peace with Henry in 1088. Conrad, the emperor's eldest son, next revolted, and was crowned in 1093. Henry put him under the ban of the empire and had his second son Henry elected his successor at the diet of Aix-la-Chapelle in 1098; but Henry was also induced to revolt by the inveterate enemies provoked by the reforms of the emperor, who was deposed in 1105, and died in the following year unabsolved by the Church.

Henry V., who had dethroned his father at the instigation of the Pope, inherited notwithstanding the quarrel with the Church about investitures. He was also engaged in wars with Hungary, Bohemia, and Flanders, in which he was frequently unsuccessful. He was excommunicated by seven councils and his subjects were incited to revolt by the papal legate. At length in 1122 he settled the question of investitures with Pope Calixtus II. He died in 1125. On his death there was a contested election and a civil war between Lothaire, Duke of Saxony, and Conrad of Hohenstauffen, in which the former was successful. A contest was now begun between the Saxon and Hohenstauffen (Suabian) families, in which the celebrated party names Guelph and Ghibelline originated. On the death of Lothaire in 1138 Conrad III. (of Hohenstauffen) was chosen to succeed him. The most powerful of his vassals was Henry the Proud, Duke of Saxony and Bavaria. At the diet of 1138 Henry was summoned to resign one of his duchies on the plea that it was contrary to the fundamental laws of the empire for the same person to hold two. On his refusing he was deprived of both and put under the ban of the empire. In May 1147 Conrad set out on the second crusade, from which he returned in 1149. He died in 1152, and was succeeded by his nephew Frederick Barbarossa. Frederick reconciled himself with Henry the Lion, son of Henry the Proud. Conrad had already restored to him the duchy of Saxony, and Frederick gave him back Bavaria.

Frederick is celebrated for his wars, particularly for the numerous invasions of Italy, in which the greater part of his life was passed. He held numerous diets to procure means for his campaigns and regulate the affairs of the empire. In this reign municipalities were first established whence arose the free cities (q.v.) which form one of the most interesting chapters of German history. At the diet of Würzburg in 1180 he put Henry the Lion, who had proved ungrateful to himself and of whose tyranny there were many complaints, under the ban of the empire and deprived him of all his estates. In 1189 he set out for Palestine, and was drowned near Seleucia 10 June 1190. His son Henry VI. began his reign with a war in Southern Italy. He imprisoned Richard I. of England, 1192–4. Like his father he was excommunicated by the Pope. He conquered Sicily and was crowned king of it in 1194. He died in Messina in 1197. Philip, brother of Henry, and Otto IV. were elected by rival factions in 1198. Philip, who was successful, was assassinated in 1208. Otto IV., the son of Henry the Lion, was recognized by the Diet of Frankfort in 1208 as the successor of Philip. After superintending the execution of severe edicts against the brigands of Germany he passed into Italy in 1209 and occupied himself with the conquest of the kingdom of the Two Sicilies, of which Frederick, son of the Emperor Henry VI., had been acknowledged king till 1212, when the Pope having stirred up a party against him, he returned to that country, but was unable to make head against Frederick, who had been elected to replace him, and retired to his hereditary dominions, of which his rival could not deprive him. He died in 1218.

Frederick II., King of the Sicilies, was elected emperor in 1212. One of the most remarkable characters in the 13th century, his life was passed in contentions with the popes about the Crusades and matters connected with Italian politics. The Lombard league was renewed against him. He was repeatedly excommunicated, and though he went on a crusade failed in all his efforts to reconcile himself with the Church. He passed a severe law against heretics and to put an end to the Guelph and Ghibelline factions in Germany, he erected the duchy of Brunswick for the descendants of Otto (1235). The independence of the German princes was legally established in his reign. Two rival emperors were put up against him by the Church party — Henry, Landgrave of Thuringia, in 1246, and William, Count of Holland, in 1247. He died in 1250. Conrad IV., his son, was excommunicated like his father, and had to contend against William of Holland. He died in 1254. He was the last emperor of the house of Hohenstauffen, which became extinct on the death of his son. His successor, William of Holland, was slain in Friesland in 1256. Richard, Earl of Cornwall, and Alfonso X., King of Castile, were chosen emperors in 1257; but the internal divisions of Germany had already deprived the office of all authority, and neither of them had any power. Till 1273 the German empire had no real head.

Rudolph of Hapsburg, the founder of the Austrian house, was chosen emperor in that year, and applied himself vigorously to repress the disorders to which this state of anarchy had given rise. He destroyed the castles of more than 70 robber nobles and executed many of the criminals. He also contrived to enrich his own family by his victories over the King of Bohemia and the recovery of the duchy of Austria, with which he invested his son Albert. He died in 1291. Adolphus of Nassau, his successor, was deposed in 1298 by the Diet of Mentz, which alleged a heavy list of crimes against him. Albert I., son of Rodolph, was chosen emperor the same year. He is chiefly celebrated for his wars with the Swiss as Duke of Austria, which led to the independence of

Switzerland. He died 1 May 1308, and was succeeded by Henry VII., of Luxemburg, nearly the whole of whose reign was passed in Italy, where he died in 1313. He obtained the kingdom of Bohemia for his son. In 1314 a double election took place, Frederick, Duke of Austria, sometimes called Frederick III., was elected along with Louis of Bavaria, and after a civil war was acknowledged as joint emperor in 1325. He died in 1330. Louis V., who now became sole emperor, was engaged in constant quarrels with the popes. He died excommunicated and deposed in 1347. Charles IV., King of Bohemia, and grandson of the Emperor Henry VII., was elected on the deposition of Louis in 1346. He was chiefly occupied with the care of his hereditary dominions and was little respected in Germany. His reign is chiefly distinguished for the Golden Bull (1356) regulating the electorate, which is treated of elsewhere. Several rivals were opposed to him at the beginning of his reign. He died in 1378. Wenceslaus, his son, was deposed for his excesses first by the electors of the empire in 1400. Rupert, Count Palatine, elected 1400, possessed little authority. Sigismund, King of Hungary and Bohemia, son of Charles IV., was elected by a party in 1410, and unanimously in 1411. His reign is distinguished by the commencement of the Reformation in Bohemia, by the Council of Constance, the condemnation of Huss and Jerome, and the burning of the former in violation of the emperor's safe conduct. He died in 1437. Albert II. (V. of Austria), son-in-law of Sigismund, was elected in 1438, and died in the following year. He was succeeded by his second cousin Frederick, Duke of Styria and Carinthia, usually called Frederick III. His character was feeble and his authority small. The empire was disturbed with commotions which he hardly tried to suppress. He was engaged in war with his brother Albert for his hereditary estates, and with George Podiebrad and Matthias, Kings of Bohemia and Hungary, on which kingdoms he had claims. He was also involved in the disputes between France and Burgundy. Yet he has earned the epithet of Pacific. He originated the famous motto of the house of Austria — *a. e. i. o. u.* (*Austriæ est imperare orbi universo* — It is Austria's part to rule the whole world), and though unsuccessful in all his plans, he did something to justify it in marrying his son Maximilian to the heiress of Charles of Burgundy. In his reign Constantinople was taken by the Turks. He died in 1493, and was succeeded by his son Maximilian I. His marriage with Mary of Burgundy brought the Netherlands again into close relationship with the empire and revived claims on Burgundy which he was unable to maintain against the rising power of France. In 1496 his son Philip married Joanna, the daughter of Ferdinand and Isabella of Spain. The French monarchy, consolidated by Louis XI., had already entered on the sphere of European politics, and with the invasion of Italy by Charles VIII. in 1494 had begun that contest for supremacy with the rival power of Germany, which, whether in the form of a conflict between rival monarchies, or of a deadlier struggle between opposed nationalities, has continued to the present day. Maximilian invaded Burgundy in 1498, but was compelled to submit his claims to arbitration. With the support of the diet he also endeavored to revive the claims of the empire on Switzerland, and reduce it under the authority of the newly created Imperial Chamber. A bloody war ensued in 1499, in which he was defeated and compelled to make peace. He was constantly frustrated in his wars by want of means to keep his armies together. France, Spain, and Germany, after struggling and intriguing with alternate success for the supremacy in Italy, united in 1508 with the Pope in the celebrated league of Cambrai against Venice. Maximilian abandoned this league in 1511 to enter into another fomented by the Pope, and hence called the Holy league, with Spain and England against France. About the same time he made a curious attempt to get himself on the next vacancy elected pope. In 1516 he invaded Italy, but the insubordination of his troops for want of pay compelled him to make an ignominious flight. In 1518 the affairs of Luther were first brought before the Diet of Augsburg. Maximilian died in 1519. He was succeeded by his grandson, Charles V., who had inherited the crown of Spain through his mother, and thus united under his sway a great part of Europe with the rich possessions of Spain in the New World.

The reign of Charles, the most important in the German annals and the most brilliant in the 16th century, was divided among three great conflicts — the continued struggle between France and Germany; the conflict with the Turks, whose encroachments threatened the hereditary dominions of the house of Austria; and the kingdom of Hungary, which, together with Bohemia, fell after the death of Louis II. at the battle of Mohacz to the emperor's brother Ferdinand; and the conflict with the Reformation. In the first of these Charles enjoyed his most brilliant successes, particularly in the victory of Pavia (1525), which made Francis I. his prisoner; but Charles' seeming preponderance of power was very nearly balanced by the more central position of France and the more available character of her resources, and after all his successes he only succeeded in bequeathing to his son Philip of Spain an unfinished war, suspended by a truce which left France in possession of Savoy and the frontier fortresses of Metz, Toul, and Verdun. The material results of this struggle in the various treaties with France which resulted from it will be found in our history of that country, and its various incidents and episodes, the alliances of both kings with England, the defection of Bourbon, the emperor's quarrel with Clement VII., the sack of Rome, in the respective biographies. The war with the Turks became formidable, when, after his victory at Mohacz (1526), Solyman set up a king of Hungary and laid siege to Vienna (1529); and his repeated invasions of Hungary and alliances with France continued to harass the empire till the close of Charles' reign. This war also had its episodes in the naval expeditions of Doria and the emperor to Tunis (1535) and Algiers (1541).

But the most important feature of Charles' reign was the struggle with the Reformation (q.v.), and in it he can be credited with neither glory nor success. It cannot be disguised that his policy with the Reformers was tortuous.

When his foreign policy required it, and particularly when pressed by the Turks, he made concessions freely; but when, with the active assistance of the Reformers he had been relieved from this danger and had been left at liberty by the Peace of Crespy (1545) to attend to the internal affairs of the empire, he speedily withdrew his concessions. The league of Schmalkalden, with which the emperor had concluded the Peace of N iremberg in 1532, through the bad generalship and divided counsels which are inherent in such combinations, suffered a decisive defeat at Mühlberg in 1547; but Charles was not yet wholly master of the situation, and the famous Interim of the Diet of Augsburg in 1548 was the fruit of his victory. But this success was dearly purchased. Maurice, whom he had made Elector of Saxony, put himself at the head of a new league, which did not commit the faults of its predecessor, and extorted the treaty of Passau in 1552, by which the whole policy of the emperor's reign was overturned and the liberty of Protestant worship secured. In 1554 Charles negotiated the marriage of his son Philip with Mary of England. The treaty of Passau had provided for referring the religious disputes to a diet, and at the Diet of Augsburg in 1555 a religious peace was negotiated by Ferdinand, the emperor's brother. It contained two provisions, which ultimately aggravated existing differences and were a main cause in promoting the Thirty Years' War. The Lutherans were then the chief body of Reformers in Germany, but the Calvinists were rapidly increasing in numbers and influence. The toleration granted by the peace was limited to the followers of the confession of Augsburg. One of the great causes of difference between the Catholics and the Reformers was the great amount and peculiar tenure of ecclesiastical property to which we have already alluded. The secularization of this property was looked on as a profanation by the Catholics, while the Protestants could not be expected to see with complacency possessions which conferred political power and dignity to the extent of direct personal authority exclusively in the hands of their enemies. A large amount of ecclesiastical property had already been secularized through the conversion of its holders. This was in fact a powerful motive to conversion, as the Church did not give hereditary possession. The Catholics now succeeded in securing an article called the Ecclesiastical Reservation, by which any holder of an ecclesiastical benefice changing his religion should forfeit the benefice. This seemingly reasonable provision excited the strenuous opposition of the Protestants, and was only permitted to pass under protest. In 1556 Charles resigned the empire to his brother Ferdinand. The Netherlands and the Italian possessions, for which so much German blood had been spilt, had already been given with the kingdom of Spain to his son Philip. Charles retired to the monastery of St. Just in Estremadura, where he died in 1558.

The Pope refused to recognize the abdication of Charles and the accession of his successor, and declared the acts of the Diet of Frankfort (in 1558), which had acknowledged Ferdinand, null and void. Ferdinand in consequence assumed the title of emperor elect, and from this time coronation by the pope was no longer deemed necessary by the German emperors. Ferdinand observed the religious peace and was chiefly occupied with the affairs of his hereditary dominions. He succeeded in making Bohemia hereditary and in 1562 concluded a truce for eight years with the Turks. The Council of Trent was concluded in his reign. He died in 1564. Maximilian II., son of Ferdinand, was distinguished for the moderation of his policy in regard to religion. He extended toleration to his hereditary dominions. Maximilian was in 1566 engaged in a fresh war with the Turks in Hungary, during which Solyman died from fatigues incurred in the obscure fortress of Szigeth. Maximilian died in 1576, while he was preparing to assert his claim to the crown of Poland. His son, Rudolph II., who had been brought up in Madrid, was, in contrast to his father, a Catholic zealot, and soon rendered himself unpopular by his persecution of the Protestants and by his complete incapacity for government. The Archduke Ferdinand of Styria, and Maximilian, Duke of Bavaria, also distinguished themselves by their zeal for the Catholic religion. The latter procured a decree of the Aulic Council putting the free imperial city of Donauwörth under the ban of the empire, and entrusting him with its execution. The proceedings which followed, known as "the troubles of Donauwörth," occasioned the formation of the Protestant Union 4 May 1608. This was followed by a counter-association on the part of the Catholics (July 1609), called the Holy league. A war with the Turks was favorably concluded by the Peace of Sitvatorok in 1607. In 1609 Rudolph was compelled by his Bohemian subjects to sign a *Majestätsbrief* granting complete religious liberty, which was one of the proximate causes of the Thirty Years' War. He was forced in 1608 to resign to his brother Matthias the crown of Hungary, and in 1611 that of Bohemia. He died in 1612.

Matthias, who succeeded him as emperor, was not a much better ruler than his brother, and Germany under his reign continued rapidly to become more disorganized. With the consent of his brothers he adopted his cousin, Ferdinand of Styria, as his successor, and resigned to him the crowns of Hungary and Bohemia during his lifetime. He died in 1619. Ferdinand II. was more capable than his two immediate predecessors; but chronic religious strife made his reign calamitous. His Bohemian subjects were already in open revolt and offered the crown of Bohemia to the Elector Palatine Frederick V., who, though the Protestant Union was divided in opinion on the subject, decided to accept it. Frederick was defeated in the battle of Prague (8 Nov. 1620), put under the ban of the empire, and deprived of his estates, which, together with the electorate, were given to the Duke of Bavaria in 1623. These events form the commencement of the Thirty Years' War, the details of which will be found in a separate article. The invasion of Germany by Christian IV. of Denmark in 1625, the Peace of Lübeck (27 May 1629), the invasion of Gustavus Adolphus (1630), the battles of Leipsic in 1631, of the Lech and Lützen in 1632, of Nördingen in 1634, the war with France in 1635, belong to the history of the Thirty Years' War, and the policy of Richelieu.

The troubles of this period were increased by the edict of restitution passed in 1629, which revived the Catholic claims on all Church property secularized since the Peace of Passau in 1629. Ferdinand died in 1637. His son, Ferdinand III., had gained a military reputation by the battle of Nördlingen, but he did not put it to the proof by taking the command of his armies. Baner, Frederick of Saxe-Weimar, Torstenson, Turenne, and the great Condé gained repeated victories over his troops. He was at length induced to enter into negotiations. The war, through complication with the affairs of Spain and the Netherlands, had gradually extended throughout Europe.

A congress of nations was opened in the towns of Münster and Osnabrück, the Catholic powers being represented at the former and the Protestant at the latter (1643); and after some years of fighting and negotiation the Thirty Years' War was concluded by the Peace of Westphalia (24 Oct. 1648), in which the policy of France and Sweden was triumphant. The principal conditions which concerned Germany were a general amnesty and restoration of rights; the Upper Palatinate was retained by Bavaria, the lower, with a new electorate, was restored to Charles Louis, son of Frederick V.; the diets of the empire were to have the sole power of making and interpreting the laws, of levying taxes, raising troops, making treaties, and declaring war; the imperial chamber and the aulic council were to be reformed so as to give greater power to the Protestants; and the right of the princes and states to make war and alliances among themselves or with foreigners was recognized. Thus the policy of the Diets of Nuremberg, Worms, and Frankfort was defeated, and the consolidation of the German empire frustrated, the great aim of Richelieu. The bishoprics of Metz, Toul, and Verdun, with Breisach, Upper and Lower Alsace and 10 imperial cities, were ceded to France; the independence of Switzerland was acknowledged, and the claims of the empire on the Netherlands abandoned, and some cessions of territory were made to Sweden.

After the Peace of Westphalia Ferdinand continued to afford the Spaniards material assistance in their war with France. Two leagues formed in Germany after the Peace of Westphalia, called respectively the Catholic and the Protestant league, enabled France to maintain its influence in the affairs of Germany, and several of the German princes entered into the French alliance. The Peace of Westphalia was confirmed by the Diet of Ratisbon in 1654. The emperor died in 1657. His son, Leopold I., was already King of Hungary and Bohemia (1655–6). He was elected emperor in 1658, although the French ambassadors who were admitted to the electoral diet made an effort to divert the imperial crown from the house of Austria. They succeeded in imposing as a condition of his capitulation that he should not assist the enemies of France in the war then in progress. Further to secure the neutrality of Germany in the war with Spain, Mazarin also succeeded by his influence with the ecclesiastical electors in combining the two leagues, Catholic and Protestant, into one called the Rhenish league, under the protection of France, for the maintenance of the Peace of Westphalia. This league was tacitly recognized by the emperor, who received a contingent of troops from Louis XIV., as a member of it, in the Turkish campaign in 1664. The treaty of Oliva in 1660 put an end to the war, in which Sweden, Poland, Denmark, and the electorate of Brandenburg were more concerned than the empire. In 1668 Leopold entered into the first of the series of treaties with France in regard to the claims of both monarchs to the Spanish succession, which ended in the establishment of the Bourbons on the throne of Spain. The success of Louis XIV. in his invasion of Holland led to a coalition against him, in which the emperor after temporizing for some time joined (30 Aug. 1673). The war was continued for some years and terminated by the Peace of Nimeguen, acceded to by the emperor on 5 Feb. 1679. A formidable war with the Turks broke out in 1663. Vienna, besieged in 1683, was saved by John Sobieski, King of Poland. In 1684 the Holy league was formed against the Turks with the King of Poland and the republic of Venice, and the war was continued till 1699, and concluded by the Peace of Carlowitz, when the Turks abandoned their claims in Hungary, Transylvania, and Slavonia.

The intolerance of the Austrian government and the persecutions of the Protestants had caused various insurrections in Hungary, and led the Protestants even to favor the Turks, who did not molest them. In 1687 Leopold proposed to the states of Hungary to incorporate his conquests from the Turks in that kingdom, and grant religious liberty, if they would abandon their constitution and make the kingdom hereditary. This being acceded to, his son Joseph was crowned King of Hungary. The emperor, with other German princes, joined in the league of Augsburg (9 July 1686) against Louis XIV. A protracted war, distinguished by the devastation of the palatinate, was concluded by the Peace of Ryswick, acceded to by the emperor 30 Oct. 1697. In 1692 the emperor erected Hanover into an electorate on terms which offended some of the German princes, and in 1700 he permitted the Elector of Brandenburg, Frederick III., to take the title of King of Prussia. The war of the Spanish Succession, in which Great Britain, Holland, and the empire were leagued against France was begun in 1702. The Emperor Leopold died in 1705. He was succeeded by his son, Joseph I. At the commencement of his reign insurrections occurred in Hungary and Bavaria; the Electors of Cologne and Bavaria were put under the ban of the empire; the estates of the latter were divided, and the Upper Palatinate was restored to the elector palatine. The success of the imperial arms enabled the emperor to revive the claims of his house upon Italy. Joseph died in 1711. He was succeeded by his brother, Charles VI., the claimant of the Spanish crown. The alliance against France was dissolved by the Peace of Utrecht in 1713, to which the emperor refused to accede, and was left alone against France.

After a brief campaign between Prince Eugene and Villars he acceded to the Treaty of Rastadt, negotiated between these commanders 7 March 1714, on his own behalf, and on behalf of the empire at Baden 7 Sept. 1714. The Spanish Netherlands, and Naples, Milan, Sar-

dinia, and other Italian conquests, were left to the emperor. By the Barrier Treaty (15 Nov. 1715) between the emperor and the States-General of the United Provinces, an arrangement was made for the joint garrisoning of the fortresses of Namur, Tournai, Ypres, etc. A short war against the Turks, conducted by Prince Eugene, ended, by the Peace of Passarowitz (21 July 1718), in further acquisitions to the hereditary possessions of Austria. The quadruple alliance formed by England France, Austria, and the United Provinces (1718–19) against Spain provided for mutual renunciations on the part of Philip V. and the emperor of their respective claims on Spain and the Netherlands, and a readjustment of possessions in Italy, where a war had already broken out between them. Spain acceded to the alliance after a brief resistance in 1720. Its most important consequence was the erection of the kingdom of Sardinia under Victor Amadeus II. of Savoy. The emperor having no male heirs had promulgated in 1713 the pragmatic sanction regulating the succession to his hereditary dominions in favor of his daughters in preference to those of his brother, Joseph I. This was acceded to by the states of Austria in 1719, and afterward by the other hereditary states, and having been subsequently guaranteed by England, Holland, Spain and France, eventually led to the war of the Austrian Succession.

A disputed succession to Poland led to a war between France and Austria in 1733, in which the French attacked the Italian provinces of the emperor and invaded Germany. Peace was concluded at Vienna 18 Nov. 1738, by which the emperor lost Naples and Sicily and part of his possessions in Northern Italy and acquired the duchy of Parma, while the Duke of Lorraine, who was to marry his daughter, Maria Theresa, received the arch-duchy of Tuscany in exchange for his own duchy, and France guaranteed the pragmatic sanction. In 1737 the emperor joined Russia in a war with the Turks. Peace was concluded in 1739 on unfavorable terms, Austria surrendering Belgrade and agreeing to evacuate Servia and Wallachia. The emperor died in 1740. Charles Albert, Elector of Bavaria, son-in-law of Leopold I., was chosen emperor in 1742, and crowned with the title of Charles VII. He laid claim to the hereditary possessions of the house of Austria, and had already occupied Bohemia and been crowned king of that kingdom in 1741. He had also entered into an alliance with France, Spain, Prussia, etc. (treaty of Nymphenburg), against the claims of Maria Theresa, who was supported by England, Holland, Poland, etc., called the Alliance of Hanover. So began the war of the Austrian Succession (see AUSTRIA; SUCCESSION WARS). Charles VII. was driven from Bohemia, and lost his hereditary states of Bavaria, which Marshal Seckendorf recovered for him. He died in Munich in January 1745. Francis I., Grand-Duke of Tuscany, the husband of Maria Theresa, was elected emperor at Frankfort on 13 September, and thus the house of Hapsburg-Lorraine, which had succeeded to the hereditary possessions of Austria, was recognized as the head of the empire. The war of succession was concluded by the Treaty of Aix-la-Chapelle (18 Oct. 1748), to which the emperor was not a party, though the empire lost by it some of its Italian fiefs. The chief result of the war was the annexation of Silesia to Prussia.

This peace was followed after a brief interval by the Seven Years' War (1756–63), excited by the desire of Maria Theresa to recover Silesia, in which war Austria, Russia, and France, with Saxony and other powers, combined together against Prussia. This war was concluded by the Peace of Hubertsburg (15 Feb. 1763), in which the empire was included. Prussia retained her acquisitions and Frederick II. agreed to support the election of the eldest son of Maria Theresa as King of the Romans. The death (in 1765) of Francis I., who had exercised little influence on political events, led to the succession of this prince as Joseph II. He was of an active and reforming disposition. He joined with Russia and Prussia in the first partition of Poland (1772). The Bavarian line having become extinct, the elector palatine succeeded to it after a war terminated by the Peace of Tesche (13 May 1779). Maria Theresa died in 1780, and Joseph succeeded to the Austrian dominions, of which he had been coregent since 1765. In 1781 he put an end to the Barrier treaty, and razed the fortresses which the Dutch were entitled by it to occupy. In the same year he issued a decree abolishing monastic orders and making other ecclesiastical reforms, and also an edict of religious toleration.

These reforms, which procured him the title of the philosophic emperor, caused much discontent to his Catholic subjects and, together with other grievances, caused a revolt in the Netherlands (see BELGIUM), which was not suppressed till after his death, which occurred in February 1790. He was succeeded by his brother Leopold. His domestic policy was reactionary and he joined with Frederick William II. of Prussia in the celebrated Declaration of Pilnitz (27 Aug. 1791) against the promoters of the French Revolution. He died 1 March 1792, and was succeeded by his son, Francis II. Francis confirmed the alliance of his father with Prussia, and was immediately involved in war with France. He joined in 1793 in the second partition of Poland. He took the command of his army against the French in 1794, concluded the peace of Campo Formio with Bonaparte (17 Oct. 1797); joined the second coalition against France in 1799 and concluded the treaty of Lunéville (3 Feb. 1801); joined the third coalition in 1805, and concluded the Treaty of Presburg (26 Dec. 1805). The results of these treaties may be found in our history of France. In 1804 Francis took the title of hereditary Emperor of Austria, and after the Peace of Presburg, the German empire having virtually dissolved by the Confederation of the Rhine, he renounced on 6 Aug. 1806 the title of its head. From this period till 1815 there is no united history of Germany.

The states of Germany were again united by the Treaty of Vienna (1815), in a confederation called the German Confederation (*der Deutsche Bund*); its proceedings, however, possessed for a time very little interest or importance. In 1818 a general commercial league, called the Zollverein, was projected by Prussia and was gradually joined by most of the German states except Austria. Germany had dur-

ing the French revolution imbibed liberal ideas which caused frequent troubles in the different states and more general outbreaks in 1830 and 1848. In the latter year the confederation underwent a revolution, and a constituent assembly was substituted for the diet. The diet was re-established in 1851. A reform of the confederation proposed by Austria in 1863 and accepted by the diet was rejected by Prussia. In 1866 the majority of the diet supported Austria in her dispute with Prussia respecting the disposal of the duchies of Schleswig and Holstein which had been jointly occupied under the authority of the confederation, whereupon Prussia withdrew from the confederation and declared it dissolved. The Seven Weeks' War between Austria and Prussia ended in the defeat of the former, the loss of her Italian possessions, and her exclusion from the German Confederation which was reformed by Prussia under the title of the North German Confederation. Peace was signed at Prague between Austria and Prussia on 23 Aug. 1866. Secret treaties of alliance had previously been entered into between Prussia and Würtemberg (13 August), Baden (18 August), and Bavaria (22 August). These were made public on 23 March 1867. The next great event was the war with France, which arose out of an offer of the crown of Spain to a Prussian prince (see FRANCO-GERMAN WAR), and resulted in the triumph of the German arms. In this great struggle the South German states, as well as the North German, supported Prussia. When the result of the war was no longer doubtful, the King of Prussia was invited to assume the title of German emperor, and he was accordingly proclaimed at Versailles on 18 Jan. 1871. The parliament of the new German empire met at Berlin on 21 March, and the constitution was adopted. The Emperor William I. died on 9 March 1888, and was succeeded by his son Frederick, who died on 15 June of the same year. Frederick's elder surviving son then ascended the imperial throne as William II., and has shown himself to be a monarch with a mind and will of his own, and a man of striking and somewhat peculiar personality.

The consolidation of the German empire was largely the work of Prince Bismarck, who became the first imperial chancellor. He successfully sought to secure Germany from attack, so as to enable her to develop her industries in peace, partly by the maintenance of a powerful, well-trained army, and partly by alliances with other powers. In 1879 he formed an alliance with Austria, and three years later with Italy. This Triple Alliance, as it is called, has been renewed in several subsequent years. During the earlier years of the reconstituted empire he was engaged, with the support of the powerful National Liberal party, in a contest with the papacy regarding the relations between the imperial government and the Roman Catholic religious societies of Germany. The Jesuits and similar orders were expelled in 1872, and a law was passed in 1874 making marriage a civil contract; but in 1880 and the years immediately following he found it expedient to open negotiations with papal representatives. Ultimately he admitted defeat by practically repealing the "Falk laws," as the anti-papal legislation was called after a Prussian minister of worship, and the last remnant of anti-Catholic legislation was repealed in 1904. It was Bismarck who in 1884 inaugurated German colonial development by declaring a protectorate over territories in Southwest Africa. (See COLONIES.) In his campaign against social democracy, which has become an important factor in German politics, Bismarck did not rely exclusively on force and repression. He sought to destroy the social discontent in which much of the strength of Socialism lay by passing measures intended to improve the condition of the working classes. In this respect his policy has also been maintained to the present time. See GERMANY, MODERN.

Bibliography.— Arndt, 'Das Staatsrecht des deutschen Reiches' (1900); Daniel, 'Deutschland nach seinen physischen und politischen Verhältnissen geschildert' (1895); Dawson, 'Germany and the Germans' (2 vols. 1894); Gould, 'Germany' (2 vols. 1881); Headlam, 'The Foundation of the German Empire' (1897); Huber, 'Deutschland als Industriestaat' (1900); Sybel, 'Die Begründung des deutschen Reichs' or 'The Founding of the German Empire,' translated by White (7 vols. 1890–4); 'Statistisches Jahrbuch für deutsche Reich' (since 1880); Thiele, 'Deutschlands landwirtschaftliche Klimatographie' (1895); Wenzel, 'Comparative View of the Executive and Legislative Departments of the Governments of the United States, France, England, and Germany' (1891); Whitman, 'Imperial Germany' (1889).

Germany, Modern. *Area and Population.*— The German Empire attained its existing territorial limits as well as its present political organization in 1871 (see GERMANY, HISTORY OF). The only territory which has been added since that time to Germany proper is the little island of Helgoland in the North Sea ceded by Great Britain in 1890. (For Germany's dependencies, see below.) Bounded on the north by the North Sea, Danish Jutland and the Baltic Sea; on the east by Russia and Austria; on the south by Austria and Switzerland; on the west by France, Belgium, Luxemburg and the Netherlands, Germany has a frontier of 4,769 miles, of which nearly one third is sea coast. Its area (exclusive of territorial waters in the North and Baltic seas and in Lake Constance) is 208,788 square miles.

The population of Germany in 1900 was 56,367,178. The increase of population from 1890 to 1895 was nearly three millions; from 1895 to 1900, over four millions. The excess of births over deaths in 1902 was 902,243. German emigration over sea (chiefly to the United States), which during the 19th century amounted to 6,500,000,— which in 1853 was 318,000 and in 1881 was 221,000,— has gradually decreased, in consequence of Germany's industrial development, until from 1897 to 1901, inclusive, it averaged only 23,000. In 1902 and 1903, in consequence of industrial depression, the numbers increased again, but in 1903 there were only 36,310 emigrants, of whom 33,649 went to the United States.

The average number of inhabitants to the square mile, which in 1871 was 197, had increased in 1900 to nearly 270. Apart from the city states (Hamburg, Lübeck and Bremen) the most densely populated of the German states is the kingdom of Saxony, which in 1900 had 728 inhabitants to the square mile.

The states of which the empire is composed, with their respective areas and population, are as follows:

States	Square Miles	Dec. 1, 1900 Population,
Prussia	134,621	34,472,509
Bavaria	29,294	6,176,057
Saxony	5,789	4,202,216
Wurtemberg	7,535	2,169,480
Baden	5,823	1,867,944
Hesse	2,966	1,119,893
Mecklenburg-Schwerin	5,069	607,770
Mecklenburg-Strelitz	1,131	102,602
Saxe-Weimar	1,397	362,873
Oldenburg	2,482	399,180
Brunswick	1,418	464,333
Saxe-Meiningen	953	250,731
Saxe-Altenburg	511	194,914
Saxe-Coburg	763	229,550
Anhalt	888	316,085
Schwarzburg-Sondershausen	333	80,898
Schwarzburg-Rudolstadt	363	93,059
Waldeck	433	57,918
Reuss-Greiz	122	68,396
Reuss-Schleiz	319	139,210
Schaumburg-Lippe	131	43,132
Lippe	469	138,952
Lübeck	115	96,775
Bremen	99	224,882
Hamburg	160	768,349
Alsace-Lorraine (territory)	5,604	1,719,470
Totals	208,788	56,367,178

The movement from country to city, noticeable in all modern industrial states, has been especially marked in Germany, and the increase of its urban population had been phenomenally rapid. In 1850, in the states included in the present German empire, 65 per cent of the population were living by agriculture and only 20 per cent by manufactures. In 1882 the agricultural population of the empire still exceeded the industrial by 3,000,000, but in 1895 the industrial population exceeded the agricultural by more than 300,000. During the same period the number of persons living by trade and commerce increased by 1,500,000. In 1895 a little less than 35 per cent of the population was living by agriculture; a little more than 35.5 per cent by manufactures; 11.5 per cent by commerce. Those engaged in mining, 3.6 per cent, were not included in the above categories. In 1871 the largest city in the empire, Berlin, had 826,341 inhabitants; in 1900 it had 1,888,848. During the same period, Hamburg, the second city, increased from 239,107 to 705,738. In 1871 there was but one other city, Breslau, with more than 200,000 inhabitants, and there were but five having between 100,000 and 200,000. In 1900 Breslau had more than doubled its population, but Munich, Dresden and Leipsic had outstripped it, trebling or quadrupling theirs, and other cities had grown proportionately, so that there were 15 cities with more than 200,000 inhabitants each, as follows:

	Population, Dec. 1, 1900
Berlin	1,888,848
Hamburg	705,738
Munich	499,959
Dresden	480,658
Leipsic	456,124
Breslau	422,709
Cologne	372,529
Frankfort on the Main	288,989
Nuremburg	261,081
Hanover	235,649
Magdeburg	229,667
Chemnitz	214,030
Dusseldorf	213,711
Stettin	210,702

There were 20 other cities with more than 100,000 inhabitants; 41 with between 50,000 and 100,000; 48 with between 30,000 and 50,000; and 85 with between 20,000 and 30,000.

Language.—Placed as it is in central Europe, without natural boundaries to separate it from the surrounding nationalities, the German people has never possessed a well-rounded or perfectly defined ethnographic territory; and even if states could be built on purely theoretical lines it would be difficult to construct a Germany that should include all areas in which the German element predominates and exclude all others. In the new Germany, however, such a result is at least approximately attained. The empire includes more than four fifths of the German-speaking inhabitants of Europe, and the census of 1900 showed that of the total population (including 778,698 resident aliens), 92 per cent had no mother-tongue but German. Those speaking Polish only, or German and Polish, constituted 6 per cent of the total population; the French element six tenths of one per cent. The remainder, 1.4 per cent, was composed chiefly of Danes, Czechs, Lithuanians, Wends, Netherlanders and Italians.

Religion.—In the census of 1900, 35,231,104 men, women and children (62.5 per cent of the entire population) are counted as Protestants; 20,321,441 (36.1 per cent) as Roman Catholics; 586,833 (a trifle over one per cent) as Israelites. Of the remainder 210,265 are described as belonging to other Christian sects, and 17,535 as confessing other religions or avowing none. Western Germany, which until the beginning of the 19th century was largely ruled by Catholic prelates, and southern Germany, where the Austrian influence was formerly supreme and the counter-reformation of the 16th century swept everything before it, are predominantly Catholic; middle Germany and northern Germany are almost wholly Protestant; while in the eastern provinces, where nearly all the Germans are Protestants and all the Poles are Catholics, the confessions are approximately balanced. In the German states, as in other European countries, the maintenance of religion and of public worship is regarded as a proper function of government, and the Catholic and Protestant churches and clergy are paid by the state. Over the Protestant establishment the control of the state is very extensive. The effort of the Prussian government to exercise somewhat similar control over the Catholic church led to the so-called "culture-conflict" of the seventies, in which, on the whole, that church successfully asserted its independence.

Education.—In no country is education better organized through all its stages, from the common school to the university, than in modern Germany. Education, like religion, is a matter with which the empire has nothing to do: it appertains to the single states, and is regularly placed under the same department, namely, the ministry of worship (*Cultus*) and education. In spite of the lack of central control, fairly uniform conditions exist in the different states. In 1898 Germany had (approximately) 59,300 common schools (*Volksschulen*), with 137,000 teachers and 8,660,000 pupils. There were also 98 schools for the deaf and dumb and 32 for the blind. There were 457 normal schools or teachers' seminaries for the education of com-

mon-school teachers, 222 supported by the states, the remainder established by the municipalities or by private enterprise. Above the common school, in the German system, stand schools with a seven-year curriculum, corresponding roughly to the American high schools or "fitting schools" and colleges. Those which give a classical course are known as *Gymnasien;* those which give a liberal scientific training as *Realschulen.* There are also schools of an intermediate type described as *Realgymnasien.* Of these three types there were in 1898, 1,108 schools with 16,380 teachers and 288,000 pupils. These furnish the necessary preparation for the universities and for the higher technological institutions. For young men who cannot look forward to a university education there has been in the different states an increasing, although unequal development of a less ambitious secondary education in the so-called *Mittel-*, or *Bürger-,* or *Fortbildungsschulen.* These are largely commercial or industrial or agricultural schools. For young women, who are not admitted to the *Gymnasien,* there has been a rapidly increasing development of *höhere Mädchenschulen.* These are for the most part private schools, although many are maintained by the cities and a few by the states.

The universities, which form the crown and glory of the German educational system, are all state institutions. They furnish professional training to clergymen, physicians, lawyers, teachers of the higher grades, and state officials, and in addition they nurture in a few chosen students the spirit of research. There are 22 German universities, half of them in Prussia. The oldest is that of Heidelberg (1386); the newest that of Strassburg (1872). Berlin, Munich, Leipsic, and Bonn have of late years attracted the largest number of students, the attendance varying from six or seven thousand regularly matriculated students at Berlin to between two and three thousand at Bonn. Very many students divide their period of academic study between two or three universities. Until recently, women were not admitted to the universities, nor are they now admitted to all.

For historical rather than logical reasons, the universities have not generally attempted to give intending engineers, chemists, etc., a strictly professional training. The university professors of the natural sciences were more interested in these sciences themselves than in their application. The gap has been filled by the development of technological institutions of the highest grade. Of these there are three in Prussia and six in other states. In 1898 these institutions had 14,614 regular students, Berlin leading the rest with 4,343. Of late years commercial schools of a very high grade, practically on a level with the technological institutions, have been established in a few German cities.

Attendance at the common schools is compulsory. In 1900 the proportion of illiterates among the army recruits was less than half of one per cent in the most backward district. East Prussia, and less than one fourteenth of one per cent in the empire. In Brandenburg, among 17,584 recruits, and in Würtemberg, among 11,776 recruits, there were no illiterates.

Industry and Commerce.—As has been noted in the statistics of population, Germany has been transformed, since the middle of the 19th century, from an agricultural nation into an industrial and commercial power of the first rank. The change began in 1834, when the customs union of the German states established internal free trade with a moderate degree of protection against the rest of the world. Since the establishment of the present empire, however, Germany's industrial and commercial development has been phenomenally rapid. As regards food, it is no longer self-supporting: in 1903 the value of its cereal imports exceeded that of its cereal exports by 567,800,000 marks. It imports twice as much wine as it exports and more than twice as much tobacco. Its only important agricultural export of late years has been beet sugar; and this may perhaps be justly regarded as an industrial rather than an agricultural product. Germany's chief exports are coal, iron and steel, and machinery; cotton, linen and silk goods and chemicals. In drugs and other chemical products it almost controls the markets of the world. In the amount of its exports, as in the total of imports and exports together, it has long passed beyond France and is second, in Europe, to Great Britain only. In 1899 the total value of its imports and exports (precious metals excluded) was 9,690,000,000 marks. In 1903 the total value had risen to 11,017,000,000 marks. The German merchant marine also has grown very rapidly in the last 30 years. In 1871 the total tonnage of its sea-going vessels was 982,355, and of this only 81,994 was steam tonnage. In 1903 the total tonnage was 2,203,804, and of this 1,622,439 was steam tonnage. Germany's success in the world market is due in large measure to the co-operation of German science with German industry, and to the establishment of technical and commercial schools of a high type.

Social Conditions.— Before the law all Germans are equal, but socially there are marked class distinctions which are not without influence, notably in the matter of appointment to office. Nobles are still preferred to commoners in the army, in diplomacy, and, to a less extent, in other branches of governmental service. The middle class, the bourgeoisie, has made the greatest advance in the last hundred years. It holds nearly all the new wealth that is now accumulating with unprecedented rapidity. Little of this finds its way into the hands of the nobles, except by marriage.

While the condition of the peasants has improved, the artisan class has suffered, as in other countries, from the development of the factory system. Wages have risen faster than the necessaries of life, and the cheapening of products has brought many things within the reach of the laborer which at the beginning of the century would have seemed unattainable luxuries. But his work is harder and more monotonous and employment is more uncertain. The evolution from status to contract has made him more independent, but it has destroyed the ties which formerly subsisted between master and man, binding them to each other in relations that were not exclusively economic, but also human. The discontent of this class has found expression in the Social Democratic party. From 1878 to 1890 a fruitless attempt was made to suppress this party by special laws. At the same time serious efforts were made to improve by legislation the position of the workingmen — efforts which culminated in a remarkable scheme of state-assisted compulsory in-

surance against accident, disease, and old age. Whatever the ultimate results of these laws may be they have as yet done nothing to check the growth of the Social Democratic party. See *Political Parties*.

Political Organization.— From 1815 to 1866, Germany was organized as a loose confederation of 38 sovereign states, namely: Austria, Prussia, and 4 small kingdoms; 28 grand-duchies, duchies, and principalities, and 4 free cities. This confederation was dissolved in 1866, as a result of the conflict between Prussia and Austria; in 1867 northern Germany was reorganized into a strong federal union, with the king of Prussia as president; in 1871, during the Franco-German war, Bavaria, Baden, Würtemberg, and Hesse united with the northern states to form the German empire, and the title of its president was changed to German emperor. Of the 38 states which were members of the confederation of 1815, 3, namely: Austria, Lichtenstein, and Luxemburg, are not included in the empire; 10 others, whose territories are included in the empire, have ceased to exist as separate states; so that the empire is composed of but 25 states: 4 kingdoms, 18 grand-duchies, duchies, and principalities, and 3 free cities. Alsace-Lorraine, ceded by France in 1871, is organized not as a state but as an imperial territory (*Reichsland*). The constitution of the empire, which is simply a revision of the North German federal constitution of 1867, vests the sovereignty of the empire in the allied princes and cities, represented by appointed plenipotentiaries in the Federal Council (*Bundesrath*). In this council Prussia has 17 votes, Bavaria 6, Saxony and Würtemberg each 4, and the other states, in proportion to dignity and size, from 3 votes to 1. In this distribution of votes the federal principle is asserted, and by it the rights of the smaller states are safeguarded. Not only has Prussia, with three fifths of the total population, no majority in the Council, but it would be possible for a combination of small states, including less than one fifth of the total population, to outvote Prussia and the remaining states. So long, however, as Prussia refrains from threatening the rights of the little states no such combination can be made, and the emperors and their chancellors have thus far worked in substantial harmony with the allied sovereigns and their representatives. The German people are directly represented in the Imperial Diet. See *Imperial Legislation*.

The Imperial Administration.—The general executive power of the empire is vested in the Federal Council; but certain very important special powers, including the conduct of foreign affairs, and the command of the army and navy, are entrusted to the emperor. Internal administration is for the most part left to the single states; and such administrative powers as are conferred upon the empire are largely exercised through state officials under federal supervision and control. The central administration of the empire is conducted by a chancellor, appointed by the emperor. Under the chancellor are several secretaries of state, heads respectively of the departments of foreign affairs, of the interior, of justice, of the treasury, etc. With military affairs the chancellor has nothing to do: so far as the military administration pertains to the empire, it is under the immediate control of the emperor himself. The fact that the emperor, as king of Prussia, rules immediately over three fifths of the German people, of course greatly modifies his position and increases his power.

State and Local Government.—In the management of their own affairs the states are practically independent of the empire. Twenty-two of the states are monarchies; three, the free cities, are republics. In all the monarchic states except the two Mecklenburgs there is now constitutional government of a modern type. The Mecklenburgs have a mediæval diet of great landholders and city magistrates. Of the free cities, Lübeck has a government of a restricted democratic type; Hamburg and Bremen have governments of a mixed type.

In the larger states, notably in Prussia, the localities, especially the municipalities, enjoy a very considerable degree of self-government. Municipal self-government in Prussia dates from the reforms of Stein, at the beginning of the 19th century. An analogous system for the rural districts was established by Bismarck. The leading features of the Prussian system are compulsory and unpaid service on the part of those called to local offices, and the control of the local administration by elected councils. The Prussian system has been imitated in many of the other states.

Imperial and State Finances.—The empire has the power of levying import duties and excises. Its revenues are derived chiefly from import duties; from excises on brandy, wine and beer, sugar, salt and tobacco; and from stamp duties. It also draws a profit from the administration of the postal and telegraph system and from the management of the imperial railways. If further revenues are required, these are provided by contributions from the single states in proportion to their population. The debt of the empire, at the close of the year 1902, amounted to 3,173,500,000 marks.

The revenues of Prussia and of the other states are chiefly derived from direct taxes, especially income taxes and succession duties; from the administration of the state domains, forests and mines, and from the management of state railways. State lotteries are still in existence.

Taxes on real property are levied chiefly for the support of local government.

Imperial Legislation.—The legislative power of the empire extends over all matters of common or national concern, including the entire field of civil and criminal law. This power is exercised by the Federal Council and the Imperial Diet (*Reichstag*). This latter body represents not the states but the German people, and its members are directly elected by them, every male German 25 years old, not convicted of crime nor dependent upon public support, having the right to vote. A Diet may be dissolved and new elections ordered, with the consent of the Federal Council, at any time; but except in case of such dissolution the term of the Diet is five years.

The assent of the Diet is required not only for new legislation but for the imposition of taxes and for all appropriations. The strength and organization of the army is commonly determined for a period of years in advance: but the budget of imperial receipts and expenditures is submitted annually for approval.

The imperial constitution is amended by the

ordinary process of legislation, that is, by concurrent action of the Diet and the Federal Council, the only difference being that a bill amending the constitution may be defeated by 14 negative votes in the latter body. As Prussia has 17 votes, and these are cast in accordance with the instructions of the king, the emperor as king of Prussia has practically the power of vetoing constitutional amendments.

Political Parties.—German political parties are numerous, and these separate easily into more or less independent "fractions." At no time, since the empire was formed, has a single party had a majority of votes in the Diet. The principal parties are the Conservatives, always divided into two and sometimes into three fractions; the Liberals, with even more fractions; the "Centre" or Catholic party, which for many years has been the strongest single group; and the Social Democrats, who at present (1905) constitute the second strongest group. This party, which in 1867 had but two representatives in the North German Diet, elected 24 members of the Imperial Diet in 1884, 57 in 1898, and in 1903 it cast more than 3,000,000 votes and elected 77 members. It appears, however, that as this party grows stronger, it is becoming less uncompromisingly intolerant of the capitalistic régime, and more inclined to aid in bettering the position of its constituents, the workingmen, within the existing social order.

Law and its Administration.—Before the formation of the North German Federation in 1867 Germany was governed by a multiplicity of laws. In civil matters, the Roman law was in theory common law; but in three fourths of Germany the Roman law had been superseded by local codes. There were different laws not only in each state but in many instances in different parts of the same state. A first step toward the unification of the law was taken in the confederate period: a commercial code drafted by commissioners of the several states was put in force by the nearly unanimous action of the state legislatures. The North German Federation adopted a common criminal code; the legislation of the new empire has produced national codes of civil and criminal procedure and finally, in 1897, a general civil code.

Justice is administered, primarily, by state courts; but the organization, competence and procedure of these courts are determined by imperial laws. The lowest courts, which deal with petty civil and police cases, are described as *Amtsgerichte* and are composed of a single judge and two lay assessors (*Schöffen*). The ordinary court of first instance is the *Landgericht* (or *Stadtgericht*), in which civil cases are determined by the judges alone. In criminal cases a jury is impanelled, and the court becomes a *Schwurgericht.* There are also special commercial courts (*Handelsgerichte*) in which cases are decided by professional judges with expert lay assessors. From the ordinary courts and commercial courts appeals run to superior courts (*Oberlandesgerichte*). The majority of the German states are too small to constitute separate appellate districts. In some cases several of them are grouped into a single appellate district; in other cases they are placed under the appellate jurisdiction of the *Oberlandesgericht* of a larger neighboring state. At the apex of the judicial system stands the imperial court (*Reichsgericht*), to which appeals run from all the state courts on questions of law. This court has also original jurisdiction in a limited range of cases. The imperial court can pronounce state laws void if they conflict with the provisions of the imperial constitution; and it can refuse to apply ordinances proceeding from imperial or state authorities if these trench on the field of legislation; but they cannot pronounce an imperial law invalid as being contrary to the imperial constitution, because the Imperial Diet and the Federal Council have power to amend the constitution, and the courts cannot go behind the declaration of the Federal Council that the law was passed and inquire by what majority it was passed.

The German Army.—In time of peace the armed forces of Prussia, of Bavaria and of the other states are, in a sense, separate bodies, each under command of the sovereign of the state. The duty of every male German citizen to serve in the army is, however, established by the imperial constitution; the strength and general organization of the army are determined, from time to time, by imperial law; the emperor is commander-in-chief of all the German forces, appoints or approves appointments to the higher military positions, and possesses general powers of inspection and control over the non-Prussian as well as the Prussian forces. Moreover, by special treaty arrangements, the contingents of nearly all the smaller states have been fitted into the Prussian organization.

The general military system is that which was devised by Prussia in the early part of the 19th century and which has since been imitated by the other states of continental Europe. The army, on its peace footing, consists of permanent officers and of a constantly changing body of private soldiers. Every male German who is not physically incapacitated owes military service from the completion of his twentieth to the completion of his thirty-ninth year. The first seven years are passed (*a*) "with the colors" and (*b*) in the reserve. For the infantry, the period of service with the colors is two years; for the artillery and cavalry, three years. After completing his seven years in the active army and the reserve, the German passes for 12 years into (*c*) the *Landwehr.* Of these 12 years, the infantry soldier passes 5 years, the artillerist or cavalryman 3 years, in the first ban of the *Landwehr.* So long as he is enrolled in the reserve or in the first ban of the *Landwehr*, the citizen is liable to be called into camp from time to time for a period of a few weeks. From those citizens who for any reason have been excused from active service with the colors there is formed (*d*) a garrison reserve, with periodical training. After serving 12 years in the garrison reserve, its members are enrolled, until they are 39 years old, in the second ban of the *Landwehr.* In addition, every German between the completed seventeenth and the completed thirty-ninth year who is not enrolled in any of the four bodies above enumerated, belongs to (*e*) the first ban of the *Landsturm;* and every German between the completed thirty-ninth and the completed forty-fifth year belongs to (*f*) the second ban of the *Landsturm.* The *Landwehr* of the second ban and the *Landsturm* are summoned only in time of war. It should be added that young men who have obtained a higher education and who can

pay for their own equipment and maintenance, the so-called "volunteers," are held to but one year's service with the colors. In 1904 the standing army ("with the colors") numbered 29,404 officers, including surgeons, paymasters, etc.; 81,955 subaltern officers, and 495,500 men, not including the one-year volunteers. A law adopted 1 April 1905 provided for a gradual further increase of the standing army, so that by 1909 it should include, besides officers and volunteers, 505,839 men. Service in the ranks is regarded as a civic duty and is unpaid. In 1904, the appropriations for the army, excluding pensions and also the cost of expeditions to Southern Africa and to China, but including the non-recurrent expenditures, which figure to a varying amount in every budget, was 646,147,590 marks.

The German Navy.—A Prussian navy was started in 1844 with a single corvette. The revolutionary German government of 1848 built a fleet to fight the Danes, but in 1852 the Federal Diet ordered its dissolution and the ships were sold at auction. With the establishment of the present empire provision was again made for an imperial navy, and in 1880 this navy was reckoned the third strongest in the world. In 1897, however, Germany had fallen back to the sixth place. In the following year the emperor secured from Parliament authority for the building of a number of new vessels, and during the year 1900 a still more extensive programme of construction was sanctioned. In 1905 the navy included 26 armored warships, 8 armored coast guard vessels, 12 armored gunboats, 10 first-class cruisers, 32 second-class cruisers, and 43 miscellaneous vessels. The personnel consisted of 1,899 officers and 35,990 subaltern officers and men. Service in the navy, except as regards the officers, is unpaid. Like the active army, the active navy is a training school, and service at sea is an alternative method of discharging the universal duty of preparation for war. In 1904 the appropriation for the navy amounted to 99,301,578 marks for ordinary expenses and 129,268,970 marks for non-recurrent expenses. The latter item, of course, represented in the main the cost of new vessels under construction.

The German Dependencies.—Germany's foreign empire was started in 1884 and 1885 by the proclamation of a protectorate in various unoccupied territories in Africa and in the Pacific Ocean where German merchants had established themselves. Bismarck declared that these dependencies were not regarded by the imperial government as fields for German colonization, but as markets for the output of German industry. In 1897 Germany seized the harbor and city of Kiaochau and secured from the Chinese government a long lease of this city with the adjacent territory. It has since asserted a sphere of influence embracing the whole province of Shantung. In 1899 Germany purchased from Spain the Caroline, Pelew, and Ladrone Islands. In 1900, by arrangement with Great Britain and the United States, it established exclusive control over a portion of the Samoan group. According to statistics of 1903, Germany's African possessions, namely, Togo, Cameroon, German Southwest Africa and German East Africa, comprise 908,215 square miles of territory, with 11,447,000 colored and 6,757 white inhabitants. The German possessions in the Pacific, namely: New Guinea, Kaiser Wilhelm Land, the Bismarck archipelago, the Solomon and Caroline islands, etc., the Marshall and the Samoan islands, amount to 94,142 square miles, with 448,000 colored and 1,031 white inhabitants. The Kiaochau lease covers 213 square miles, with 120,041 Chinese and 3,735 white inhabitants. Thus far the dependencies have not been remunerative. In 1904–05 76,737,240 marks were appropriated for the administration of the dependencies, and of this sum 51,687,724 marks were to be supplied by the taxpayers at home. In addition, the imperial budget contained appropriations of 13,277,047 marks for military expeditions to Southwest Africa and Eastern Asia. Germany's exports to all these territories in 1903 were valued at 23,500,000 marks.

MUNROE SMITH,
Professor of Roman Law and Comparative Jurisprudence, Columbia University.

Germany, Rulers, Emperors, and Kings of. From the time of the "migration of the nations" in the latter part of the 5th century until the subjugation by Charlemagne, Germany was divided into numerous principalities or states, and therefore no "ruler of the whole people" was known until Charlemagne was proclaimed emperor in 800 A.D., though he himself had reigned over several states since 768. From that time until the present they have been as follows:

NAME	Dynasty	Date of Reign
Charles I., or Charlemagne the Great	Carlovingian	800–814
Lewis the Pious, or Louis "Le Débonnaire"	Carlovingian	814–840
Lothaire I.	Carlovingian	840–843
Lewis II. the German (king and emperor)	Carlovingian	843–876
Charles the Bald (Disputants)	Carlovingian	876–882
Louis the Stammerer (Disputants)	Carlovingian	
Louis II. (Disputants)	Carlovingian	
Carloman (Disputants)	Carlovingian	
Charles III. the Fat (king and emperor)	Carlovingian	876–887
Arnulf (Arnold I., king and emperor)	Carlovingian	887–899
Lewis the Child	Carlovingian	899–911
Conrad I.	Franconian	911–918
Henry I. the Fowler	Saxony	919–936
Otto I. the Great	Saxony	936–973
Otto II.	Saxony	973–983
Otto III.	Saxony	983–1002
Henry II. the Holy	Saxony	1002–1024
Conrad II. the Salique	Franconian (dynasty restored)	1024–1039
Henry III.	Franconian (dynasty restored)	1039–1056
Henry IV. (whose reign was interrupted by the four following)	Franconian (dynasty restored)	1056–1106
Rudolph of Swabia (elected by the Pope)	Franconian (dynasty restored)	1077–1081
Herman of Luxemburg	Franconian (dynasty restored)	1081–1087
Conrad (son of Henry IV.)	Franconian (dynasty restored)	1093–1098
Henry (son of Henry IV.)	Franconian (dynasty restored)	1105–1106
Henry V. (same as above)	Franconian (dynasty restored)	1106–1125
Lothaire the Saxon	Saxony	1125–1137
Conrad III.	Hohenstaufen	1138–1152
Frederick I. Barbarossa	Hohenstaufen	1152–1190
Henry VI.	Hohenstaufen	1190–1197
Philip of Swabia / Otto IV. (Jointly)	Hohenstaufen	1197–1208
Otto IV. (alone)		1208–1215
Frederick II. (whose reign was interrupted by the four following)	Hohenstaufen	1215–1250

NAME	Dynasty	Date of Reign
Henry (Landgrave of Thuringia) — Merely nominal	Hohenstaufen	1246–1247
William of Holland (elected by the spiritual electors) — Merely nominal	Hohenstaufen	1247–1256
Richard, Duke of Cornwall, England — Merely nominal	Hohenstaufen	1257–1272
Alphonso of Castile (never active) — Merely nominal	Hohenstaufen	
Rudolph	Hapsburg	1273–1291
Adolphus of Nassau	Hapsburg	1292–1298
Albert I. of Austria	Hapsburg	1298–1308
Henry VII	Luxemburg	1308–1313
Louis V. — Were contenders	Bavaria	1314–1347
Frederick the Fair — Were contenders	Austria	1314–1330
Charles IV	Luxemburg	1347–1378
Gunther, Count of Schwarzburg	....	1349
Wencelaus	Luxemburg	1378–1410
Rupert, Count Palatine	Bavaria	1400–1410
Sigismund of Brandenburg	Luxemburg	1410–1437
Jobst of Moravia (Pretender)	....	1410–1411
Albert II	House of Austria Hapsburg Dynasty	1437–1439
Frederick III	Hapsburg Dynasty	1440–1493
Maximilian I	Hapsburg Dynasty	1493–1519
Charles V	Hapsburg Dynasty	1520–1556
Ferdinand I	Hapsburg Dynasty	1556–1564
Maximilian II	Hapsburg Dynasty	1564–1576
Rudolph II	Hapsburg Dynasty	1576–1612
Matthias	Hapsburg Dynasty	1612–1619
Ferdinand II	Hapsburg Dynasty	1619–1637
Ferdinand III	Hapsburg Dynasty	1637–1657
Leopold I	Hapsburg Dynasty	1657–1705
Joseph I	Hapsburg Dynasty	1705–1711
Charles VI. of Bavaria	Hapsburg Dynasty	1711–1740
Charles VII. of Bavaria	Hapsb'g-Lorraine	1742–1745
Francis I	Hapsb'g-Lorraine	1745–1765
Joseph II	Hapsb'g-Lorraine	1765–1790
Leopold II	Hapsb'g-Lorraine	1790–1792
Francis II	Hapsb'g-Lorraine	1792–1806
William I.*	Hohenzollern	1871–1888
Frederick	Hohenzollern	1888
William II	Hohenzollern	1888–

* Between 1806 and 1871 utter chaos reigned and there was no responsible head of the government, the kingdom being again divided into "duchies."

Consult: Lewis, 'History of Germany' (New York 1874); Whitman, 'Imperial Germany' (1889); Sybel, 'Founding of the German Empire.'

Ger'micides, agents used to destroy or to hinder the growth of microscopical forms of plant and animal life.

Germicides may be grouped under three general heads, those that act mechanically, those that destroy life by physical means, and those whose action is chemical. Inasmuch as each particular germ is an individual with its own particular characters, definite methods for its killing must be devised. Thus it is well known that quinine, for instance, is very active in destroying animal parasites, such as the malarial organism, but it is practically of no service in combating a large number of vegetable forms; and *vice versa*, many substances which are capable of destroying plant germs are inefficient when applied to animals.

Of the physical agents, heat, light, cold, and electricity, heat is the most satisfactory. High degrees of temperature will destroy all forms of parasitic life. The animal forms succumb very readily to the influence of heat, and most of the plant parasites are destroyed by it; but whereas heat may be applied with great success as a germicide in general disinfection, it naturally cannot be used as a general agent on the body. The red-hot iron in the form of a galvanocautery, or a heated wire, makes a most efficient form of cautery to destroy the poison of dog-bite, or to destroy localized forms of tuberculosis, etc., but heat is thus limited in its application.

Cold is not an efficient germicide. Ordinary freezing temperature (32° F.) kills but very few forms of either plant or animal organisms. Even the extreme cold of liquid air does not kill bacterial spores.

Light, especially sunlight, is a very efficient germicide, but the exposure must be continued for an appreciable length of time. Sunlight is nature's great germicide. Within recent years the light given by the Röntgen ray (X-ray), by radium, polonium, thorium, and similar agents, has been used with great success in the treatment of certain parasitic skin-diseases, but whether the effects are due to any germicidal action of the light, or to a normal tissue stimulation, is not decided. It seems from experiments thus far recorded that these forms of light are not definite germicides. Various colored lights, particularly red and amber, are known to restrict the growth of certain forms of bacteria. They do not, however, destroy them. This principle is made use of in smallpox hospitals and similar institutions, but it does not seem that the results are sufficiently striking to base any general deductions thereon. Electricity is not an efficient germicide. The passage of electrical currents through water does not necessarily kill the bacteria contained therein, notwithstanding the many claims made by enterprising manufacturers of electrified water, said to be made germ-free by the electrical current. What the future may reveal along this line of experimentation it is impossible to prophesy, but thus far satisfactory evidence of the germicidal effects of electricity are lacking.

Chemical germicides are numerous, both for external and internal use, although intracellular germicides, or those that can be used within the tissues of the body, are much to be desired. The list of chemical germicides is enormous. Thousands of different agents have been used and these exhibit varying degrees of germicidal activity. As has already been said, each form of germ possesses its own powers of resistance, and each germicide its ability to kill in varying degrees of strength. The germicides in popular use are chlorinated lime, carbolic acid, creosote, alcohol, boracic acid, ammonia, formaldehyde, hydrogen peroxide, iodine and its preparations, mercury and its preparations, volatile oils of cinnamon, mustard, peppermint, turpentine, pennyroyal, oxygen, quinine, salicylic acid and its derivatives. Of these for external use, for use in closets, in bedding, for linen, etc., carbolic acid in the percentage of 1 to 50 of water, formaldehyde in percentage of a teaspoonful of the 40 per cent solution of the gas to a quart, bichloride of mercury in the proportion of 1 part to 1,000, are the most practical and convenient germicides. So far as is now known, quinine is about the only efficient chemical substance that can be used as an intracellular germicide. It has the singular property of poisoning the malarial parasites within the red blood-cell without poisoning the blood-cell itself, a selective property which most poisonous agents lack.

The great germicide of the human body, and the one that protects it in its various struggles with different forms of parasites is the blood-serum. This is a very efficient germicide, a full consideration of the action of which will be taken up under the heading of IMMUNITY. Consult: Buck, 'Reference Hand-Book of Medical Sciences' (1902), article on *Germicides;* Harrington, 'Practical Hygiene' (1901). See BACTERICIDE; BACTERIA; DISINFECTION; GERMS; IMMUNITY.

Germinal, zhăr-mē-näl, the 7th month of the first French republican calendar, 21 March–19 April.

Germina'tion, in botany, the first act of growth which takes place in an embryo plant. See SEED.

Gernsheim, Friedrich, frēd'rĭн gĕrns'hīm, German composer: b. Worms 17 July 1839. He studied at the Leipsic Conservatory, became an instructor in the Conservatory of Cologne in 1865, and in 1873 also Kapellmeister of the theatre there. In 1874 he was appointed director of the Rotterdam school of music, and in 1890 of the Stern Choral Union of Berlin. His works include chamber-music, three symphonies, and other instrumental compositions; the song-cycle 'Hafis,' for solo, chorus, and pianoforte; and various vocal compositions.

Gérôme, Jean Léon, zhŏn lā-ôn zhā-rōm, French painter: b. Vesoul, Haute-Saône, 11 May 1824; d. Paris 10 Jan. 1904. He was a pupil of Delaroche, who early credited him with originality and style. When he exhibited his 'Fighting Cocks' in 1847, Théophile Gautier wrote in *La Presse,* "Let us mark with white this lucky year, for unto us a painter is born." He followed Delaroche to Rome in 1848, and visited Russia and Egypt. He first showed his power in some Egyptian studies, but only reached the level of intensity and vividness which characterized all his succeeding work in his 'Duel after a Masked Ball.' This was followed by his 'Death of Cæsar.' In 1855 he exhibited 'The Age of Augustus,' a picture in which were harmoniously blended marvelous historic faithfulness with a powerful allegory by which the culmination of pagan civilization, and its gradual paling in the dawn of Christianity was finely suggested. His grasp of classic motifs was united to an extraordinary mastery of archæological detail, and his Roman 'Gladiators in the Amphitheatre' (1859), and 'Phryne before her Judges' (1861), are startling in the impression which they convey of antique life in its movement, sentiment, and passion. In this special department of historical genre Gérôme easily led the European painters of his century. See Claretie, 'Peintres et sculpteurs contemporains' (1884); Cook, 'Art and Artists of Our Time' (1888); Van Dyke, 'Modern French Masters' (1896).

Gerona, hā-rō'nä, Spain, a city and capital of the province of Gerona; 65 miles from Barcelona. It contains a beautiful Gothic cathedral of the 14th and 15th centuries. The town has undergone several notable sieges, particularly in 1653, 1684, 1694, 1706, and 1809, on each occasion by the French. Pop. 15,407. The province of Gerona has an area of 2,264 square miles. Pop. (1900) 299,287.

Geronimo, jĕ-rŏn'ĭ-mō, Apache chief of the Chiricahua band. In 1884–6 he became noted as the ring-leader in the harrying of Arizona and New Mexico (see APACHES). Gen. Crook forced him to a stand on 25 March 1886, but Geronimo refused to surrender except for two years, the band to be sent East with their families and then replaced on the old reservation. Crook accepted the terms and started for Fort Bowie, but on the march the entire band slipped away to the mountains and began the old forays again. The subsequent criticism of Crook, as the Indians' dupe against the protests of the settlers, caused his replacement by Gen. Nelson A. Miles, who gave the Indians no rest, till Geronimo once more surrendered, this time on condition of being sent out of Arizona. Gen. Miles ordered them sent to St. Augustine, but Geronimo and 14 others were sent to Fort Pickens, Fla., instead. He has since been held as a military prisoner at Fort Sill, Oklahoma.

Gerontes, gĕ-rŏn'tēs, in ancient Greece, a number of magistrates of Sparta who, with the ephors and kings, had the supreme power in the state. They were not eligible for election before they had attained the age of 60 years. Their number is variously stated at 20 and 32.

Gerrish, Theodore, American Methodist clergyman: b. Houlton, Maine, 19 June 1846. He served during the Civil War in the 20th Maine regiment, and was wounded four times; later entering the Methodist itinerant ministry. His publications include: 'Reminiscences of the War,' 'The Blue and the Gray,' 'Life in the World's Wonderland,' etc.

Gerry, gĕr'ĭ, **Elbridge,** American statesman: b. Marblehead, Mass., 17 July 1744; d. Washington, D. C., 23 Nov. 1814. He was a member of the Continental Congress 1776–80 and 1783–5; delegate to the constitutional convention in 1789; member of Congress from Massachusetts 1789–93; commissioner to France 1797–8; governor of Massachusetts 1810–12; and Vice-President of the United States 1813–14. It was during his term as governor that an unsatisfactory redistricting of the State took place, in which he was supposed to have taken part, whence arose the term "gerrymander" (q.v.). See Austin, 'Life of Elbridge Gerry, with Contemporary Letters' (1828–29).

Gerry, Elbridge Thomas, American lawyer and philanthropist: b. New York 25 Dec. 1837. He was graduated from Columbia in 1857, was admitted to the bar in 1860, and was a member of the State constitutional convention of New York 1867. Subsequently he became an associate of Henry Bergh in the American Society for the Prevention of Cruelty to Animals, of which he was for many years vice-president. In 1874 he was the leading organizer of the Society for the Prevention of Cruelty to Children, of which he was the president in 1876–91, and which became so closely identified with his name as often popularly to be termed the Gerry Society. He was chairman of the commission on capital punishment which substituted execution by electricity for that by hanging, in New York State (1886–8). He also held many important offices of trust, and became known for his interest in yachting affairs, having been commodore of the New York Yacht Club in 1886–93. He is a grandson of Elbridge Gerry (q.v.).

Courtesy of the Booklovers Magazine.

JEAN LÉON GÉROME.

Gerrymander, gĕr'ĭ-măn-dėr (hard g: now chiefly used as a verb), the arranging of election districts by one party in a State so as to concentrate its opponent's majorities and scatter its own, thus giving itself as many with light majorities and its rival as few with heavy ones as possible. Many States are to some extent gerrymandered by nature, the heaviest vote of one party being compacted into a minor section: Indiana and New York are notable cases — the one on account of the southern agricultural population having been kept from expansion by more energetic streams of a different character, the other from the development of a vast city at political odds with the rural parts. Law usually and fairness necessarily provide that the State shall be districted in solid blocks of contiguous territory, so that (subject to the above limitation) the district elections shall correspond roughly to the popular majorities in the State. But since early in the century, all parties in turn have often violated political equity by establishing artificial gerrymanders when in power; sometimes creating a popular revolt which has cost them the object of the scheme, but the rival party has rarely learned wisdom from that result, usually reversing the gerrymander for its own profit. As counties are fair models of what election districts should be, the gerrymander is generally worked by disregarding them; but the following illustration of its working with them is the simplest form. Suppose nine counties casting 10,000 votes each, the whole lying in a block thus arranged, and the votes divided between party A and party B as indicated within:

1 A 8750 B 1250	4 A 5250 B 4750	7 A 4850 B 5150
2 A 4500 B 5500	5 A 7500 B 2500	8 A 4750 B 5250
3 A 5100 B 4900	6 A 4300 B 5700	9 A 7000 B 3000

Now let one district be formed from the diagonal counties 1, 5, and 9, and three others, respectively, from 2 and 4, 3 and 6, and 7 and 8. Party A has 52,000 against B's 48,000 altogether or a popular majority of 4,000; but it only carries one district out of four because the gerrymander has made it waste most of its votes and its rival wastes almost none. Yet the law has been observed, as all the counties in each district are contiguous. Of course, in practice such perfect cases do not occur, and towns or counties are grouped raggedly in forms often grotesque. The origin of the name was from one of these, among the earliest. Massachusetts, in 1812, had its senatorial districts identical with the counties; the State Constitution gave the legislature the power of redistricting, however, and the Republicans, carrying the legislature in that year over the Federalists, at once gerrymandered it in a very outrageous fashion. The Boston *Sentinel* published a colored map of one district in Essex County, whose sprawling towns with a huge prong to the northwest seemed like some monstrous animal of fable; and on an indignant Federalist saying that it "looked like a salamander," another retorted, "Better call it Gerrymander," from the Republican governor, Elbridge Gerry (q.v.), whose signature had made it law. Gilbert Stuart (q.v.), the artist, drew a completion of it into an ungainly bird, which figured largely as a campaign document. The Federalists recaptured the legislature the next year and repealed the bill. The most famous of many great gerrymanders in the United States is the "Shoestring District" (Sixth Congressional) of Mississippi, formed to minimize the negro vote, and consisting of all the counties in the State touching the Mississippi River; it is about 300 miles long by an average of 20 broad.

Gerster, gär'stĕr, **Etelka** (MADAME GARDINI), Hungarian singer: b. Kaschau, Hungary, 16 June 1857. She was a pupil of Madame Marchesi in Vienna, and made her first appearance in Venice in 1876, as Gilda, in 'Rigoletto.' In 1878, and also in 1883 and 1887, she made successful tours in the United States. In 1887 she married her director, Pietro Gardini, and since 1896 has been at the head of a singing school in Berlin.

Gerstle, Lewis, Californian pioneer: b. Bavaria 17 Dec. 1824; d. San Francisco, Cal., 17 Nov. 1902. Coming to the United States as a lad, he settled in Louisville, Ky., and joined the fortune-seekers in California in 1850. With Lewis Sloss he subsequently formed the Alaska Commercial Company. Their enterprises by sea and land aided largely in building up California, and Gerstle always displayed a public spirit and faith in the future of the State. He was treasurer of the University of California, and identified with many Jewish and general charities, to all of which he was a generous giver.

Gertrude of Wyoming, a narrative poem by Thomas Campbell, written at Sydenham, in 1809. He chose the Spenserian stanza for his form of verse, and for his theme the devastation by the Indians, in 1778, of the quiet valley of Wyoming, in Pennsylvania, on the Susquehanna. The poem opens with a description of "Delightful Wyoming," which Campbell, who had never seen it, paints as a terrestrial paradise. The whole style and manner is pseudo-classic and old-fashioned; the treatment vague, unreal, and indefinite; but a certain sweetness and pathos, combined with the subject, has kept the poem alive.

Gervinus, Georg Gottfried, gā-ōrg' gŏtfrēd gĕr-fē'noos, German historian: b. Darmstadt 20 May 1805; d. Heidelberg 18 March 1871. In 1825 he went to the University of Heidelberg, where the lectures of Schlosser inspired him with a peculiar love of historical studies. In 1831 he visited Italy, where he remained for a year collecting materials for the works he was meditating. His 'Historische Schriften,' published after his return (1833), excited the attention of scholars, and secured him in 1835 an extraordinary professorship in the University of Heidelberg, where he was in 1844 appointed to an honorary professorship. From 1845 he took an active part on the liberal side in the movements then going on in Germany. It was at this period that he wrote his 'Mission der Deutschkatholiken' and 'Die Protestantische Geistlichkeit und die Deutschkatholiken.' In 1847 he founded in Heidelberg, in conjunction with Mathy, Mittermaier, and Häussy, the 'Deutsche Zeitung,' which at once became one of the leading organs of the party which advocated a representative system for Germany and a clearly defined federal constitution. His chief

works are 'Geschichte der poetischen Nationallitteratur der Deutschen' (1835–42), in which he endeavors to show how the development of German poetry is connected in all its phases with the history of the nation and other European countries; 'Shakespeare' (1849–50); 'Geschichte des neunzehnten Jahrhunderts' (1855–66). All his works, even his more purely æsthetical ones, such as that on Shakespeare, are more or less colored by his political views and aims. In the last years of his life he zealously endeavored to secure the popularity in Germany of the works of Handel, whom he regarded as the greatest genius in the musical sphere that the world had even seen. His 'Autobiography' appeared in 1893.

Geryon, jē'rĭ-ŏn, in the mythology of Greece a king of Hesperia, son of Chrysaor and Callirrhoe, a three-headed giant. He possessed numerous and fine herds, which were guarded by the two-headed dog Orthrus and the giant Eurytion. The herds were carried away, and Geryon slain by Hercules, in obedience to the command of Eurystheus.

Gesenius, Friedrich Heinrich Wilhelm, frĕd'rĭн hīn'rĭн vĭl'hĕlm gā-zā'ne-oos, German Orientalist: b. Nordhausen, Saxony, 3 Feb. 1786; d. Halle, 23 Oct. 1842. He studied at Helmstedt and Göttingen, and at Halle in 1810 became extraordinary, in 1841 ordinary, professor of theology. Here he lectured for more than 30 years, broken only by the closing of the university during the War of Liberation (1813–14), and by lengthened visits to France and England in 1820, to England and Holland in 1835. His first great work was his 'Hebrew and Chaldæan Hand Dictionary.' His 'Elementary Hebrew,' consisting of the 'Hebrew Grammar,' and the 'Hebrew Reader,' has contributed enormously to the knowledge of the Hebrew language, not only in Germany, but through translations also in England and the United States. Later works are his 'Critical History of the Hebrew Language and Literature' (1815); 'On the Origin, Genius and Authority of the Samaritan Pentateuch' (1815); 'A Critical Grammatical System of the Hebrew Language' (1817), and a new translation of and commentary on Isaiah (1820–21). His greatest work is the monumental 'Critical Grammatical System of the Hebrew and Chaldæan Languages in the Old Testament,' of which the first part was published in 1829, but which was completed only in 1858 by Rödiger. See Hayne, 'Gesenius, eine Erinnerung für seine Freunde' (1842).

Gesner, Abraham, Canadian geologist: b. Cornwallis, N. S., 2 May 1797; d. Halifax, N. S., 19 April 1864. He studied medicine in London, and returned to Nova Scotia. Later he became interested in scientific researches. In 1838 he was appointed to examine and report on the geological resources of the lower provinces of British North America. Afterward he discovered how to produce oil suitable for lamps from bituminous shale and cannel coal. He thus originated the discovery of "kerosene" (which name he gave his oil) in the United States. His publications include: 'Remarks on the Geology and Mineralogy of Nova Scotia' (1837); 'Reports on the Geological Survey of the Province of New Brunswick' (1844); 'New Brunswick, with Notes for Emigrants' (1847); 'Industrial Resources of Nova Scotia' (1848); 'A Practical Treatise on Coal Petroleum and Other Distilled Oils' (1861); etc.

Gesner, Konrad von, kōn'räd fōn gĕs'nĕr, Swiss naturalist: b. Zürich, Switzerland, 26 March 1516; d. there 13 Dec. 1565. His early studies, in medicine, natural history, and Greek and Latin literature, were prosecuted at Zürich, Strasburg, Bourges, and Paris, and in 1537 he was appointed professor of Greek at Lausanne. This chair he exchanged four years later for that of physics and natural history at Zürich. He was an indefatigable writer of books and in the course of his life published no less than 72 works, besides leaving at his death 18 others in progress. His 'Universal Library' (1545), contained the titles of all the books then known in Hebrew, Greek, and Latin, unpublished as well as published, with criticisms and summaries of each. His next undertaking was the 'Animal History' (1551–8). The first book treats of viviparous quadrupeds, the second of oviparous animals, the third of birds, and the fourth of fishes and aquatic animals. He collected more than 500 plants undescribed by the ancients, and appears to have been the first who made the great step toward a scientific classification of distinguishing genera by the fructification. He also wrote on other branches of science, as medicine and mineralogy, and composed a great number of works dealing with the ancient classics, the 'Mithridates sive de Differentia Linguarum' (1555) being the most notable.

Gessler, gĕs'lĕr, **Albrecht**, or **Herman**, called also Gessler von Bruneck, legendary Austrian official, in 1300 appointed joint-governor with Berenger von Landenberg, of the Waldstädten or forest cantons (Schwytz, Unterwalden, and Uri), by Albrecht I. of Austria. According to the traditions connected with William Tell (q.v.), his oppressive edicts and wanton cruelty so enraged the inhabitants that a conspiracy was formed against him, and he was shot by Tell in a narrow pass near Küssnacht in 1307.

Gessner, gĕs'nĕr, **Salomon**, German poet, painter, and etcher: b. Zürich 1 April 1730; d. there 2 March 1788. In 1762 he published, in four volumes, the poems which he had previously given to the world on different occasions. In 1772 he published another volume containing a collection of poems, to which he gave the name of 'Idyllen' (idyls), a name which he had already given to a previously published volume of poems. Their quiet, amiable character pleased many in Germany; and in France, where they were translated by Huber, they were received with enthusiasm, and the author was regarded as a poet of the first rank. From France his fame spread over all Europe. The most popular of his idyls is the 'Death of Abel,' since translated into many foreign languages. In landscape painting he has merits which no age will diminish. His etching is light and powerful; his views are select, wild, and romantic; and his trees are particularly fine. Twelve engraved landscapes, published in 1770, are considered among his best works.

Gesta Romanorum, jĕs'ta rō-mä-nō'rŭm, 'Deeds of the Romans,' the title of a collection of short tales, legends, etc., in Latin, very popular

in the Middle Ages. The book was probably compiled about the close of the 13th century. The separate tales making up the Gesta are of diverse contents, and belong to different times and countries, the sources from which they are derived being partly classical, partly Oriental and partly western. Whatever may have been the intention of the original compiler, they very soon were adapted to the moralizing tendencies of the time, and moral reflections and allegorical interpretations were added to them, it is said, by a Petrus Bercorius or Pierre Bercaire of Poitou, a Benedictine prior.

Gesta'tion, the period of development of the fœtus from the time of conception to birth. Even in animals, where only a single insemination is allowed, the length of the gestation cannot always be foretold with exactness. The human fœtus is carried in the uterus about 280 days. For periods of gestation in animals, see BREEDING. See also OBSTETRICS; PREGNANCY.

Geta, jē'ta, **Septimus,** Roman emperor: b. 189 A.D.; d. 211 A.D. He was the second son of the Emperor Severus, and brother of Caracalla, with whom he was associated in the empire on the death of his father. Caracalla, who envied his virtues and was jealous of his popularity, after having endeavored to effect his death by poison, murdered him, and wounded their mother, who was attempting to save him.

Gethsemane, gěth-sěm'a-nē, or **Gethsemani** (*Boustanez-Zeitoun*), an olive garden or orchard in the neighborhood of Jerusalem, on the road leading from the brook Kedron to the Mount of Olives. The place is noted for being the scene of «Our Lord's Agony in the Garden» (Luke xxiii. 39–53). It is said that when St. Helena (q.v.), the mother of Constantine, visited the Holy Land in 425, she found abundant evidences to aid her in locating the exact site of the «Garden of Olives» or Gethsemane. The place is now in possession of the Franciscan Fathers of the Holy Land who, in 1848, built a wall around it the better to protect it. They have planted many flowers which they give gratuitously to travelers who desire some memento from this historic spot. Maudrell described the place in his day (1697) as «well planted by olive trees»; but there are now only eight trees which are supposed to have been in the grove at the time of our Lord. Some historians seek to throw doubts upon the age of these trees because of the order issued by Titus to destroy all the trees within a certain limit. These trees were so near the walls that they could not well be destroyed even if the tops were cut off. From the earliest days of the possession of Palestine by the Mohammedans every olive-tree has been taxed except these trees. In the 17th century there were nine trees, but one was destroyed by tourists. The present appearance of the garden is in accordance with the description as found in the Gospels. Another site, a little to the north, is claimed by some to be the real Gethsemane. Consult: De Hamme, 'Ancient and Modern Palestine'; Vogue, 'Les Eglises de la Terre Sainte,' p. 314; Thomson, 'The Land and the Book'; Costello, 'The Gospel Story.'

Getty, George Washington, American soldier: b. Georgetown, D. C., 2 Oct. 1819; d. Forest Glen, Md., 3 Oct. 1901. He was graduated from the United States Military Academy in 1840, fought in the Mexican and Seminole wars, in the Civil War attained the brevet rank of major-general, United States army. He subsequently was commander of numerous military districts; was transferred to the artillery in 1871 and retired from the service in 1883.

Get'tysburg, Pa., a borough and county-seat of Adams County; 35 miles southwest of Harrisburg; on the Philadelphia & R. and Western M. R.R.'s. It is the seat of a Lutheran theological seminary founded in 1826, and Pennsylvania College (Lutheran) founded 1832. One of the most famous battles of the Civil War was fought here. Pop. (1900) 3,495. See GETTYSBURG, BATTLE OF.

Gettysburg, Campaign and Battle of. After the battle of Chancellorsville (q.v.), 1–3 May 1863, the opposing armies resumed their positions on the Rappahannock, Lee's army on the south side of the river, at Fredericksburg, Hooker's on the north side, opposite. Encouraged by victory, and desiring to relieve Virginia of the presence of the Union army, Lee determined to transfer the seat of war north of the Potomac. His army, 1 June, was composed of the three corps of Longstreet, Ewell and A. P. Hill, and Stuart's cavalry force of 12,000 men, in all about 76,000 men, with 190 guns. Hooker's Union army was composed of seven corps, the First, commanded by Reynolds; Second, by Hancock; Third, by Sickles; Fifth, by Meade; Sixth, by Sedgwick; Eleventh, by Howard; and Twelfth, by Slocum; aggregating, 10 June, 82,000 infantry and artillery «present for duty and equipped,» with 410 guns, to which were added Pleasonton's cavalry force of about 12,000.

Lee began his campaign 3 June by sending Longstreet and Ewell to Culpeper Court House, where the cavalry, under Stuart, was also concentrated. A. P. Hill remained at Fredericksburg to watch and detain Hooker. Hooker suspected Lee's movement and, under his direction, Sedgwick laid bridges, crossed the river, and reported that Lee's main body seemed to be still there. Pleasonton was ordered to feel the position at Culpeper. Reinforced by two infantry brigades, he crossed the Rappahannock on the morning of the 9th, encountered Stuart at Fleetwood and Brandy Station (see FLEETWOOD AND BRANDY STATION, BATTLE OF), and reported the greater part of Lee's army at Culpeper, preparing to move on Washington. Hooker sent three corps up the Rappahannock to prevent Lee's crossing. On the 10th Lee sent Ewell, preceded by two brigades of cavalry, to the Shenandoah Valley to clear it of Union troops. Ewell defeated and dispersed Milroy's command at Winchester (see WINCHESTER, BATTLE OF), took Martinsburg and cleared the valley; and on the 15th Rodes' division crossed the Potomac at Williamsport, sending Jenkins' cavalry brigade in advance to Chambersburg, and on the 19th moved to Hagerstown. Johnson's division crossed the Potomac and marched to Sharpsburg, and Early's moved to Shepherdstown to threaten Harper's Ferry. In these positions Ewell waited until the 21st for the other two corps to close up, when he advanced to Chambersburg. Longstreet moved from Culpeper on the 15th and, advancing along the east side of the Blue Ridge, occupied Ashby's and Snicker's Gaps. Stuart's cavalry was thrown out in front of Longstreet to watch Hooker, and

on the 17th had a severe fight with the Union cavalry at Aldie and was driven back to Middleburg. A series of cavalry combats ensued, at the end of which Stuart was driven behind the Blue Ridge. On the 24th Longstreet moved by way of Berryville, crossed the Potomac at Williamsport on the 25th and 26th, and marched to Hagerstown, thence on the 27th to Chambersburg. A. P. Hill remained at Fredericksburg until the 14th, when, Hooker having fallen back, he moved down the Shenandoah Valley, crossed the Potomac at Shepherdstown, and joined Longstreet at Chambersburg. Stuart was left to guard the passes of the Blue Ridge and watch Hooker, whom he was to harass as much as possible, should he attempt to cross the Potomac. Meanwhile Hooker, starting from the Rappahannock on the 13th, was moving cautiously back toward the Potomac and covering Washington. On the 25th, 26th and 27th he crossed the Potomac at Edward's Ferry, near Leesburg, and on the 28th his army was grouped about Frederick, with Slocum's corps on the left near Harper's Ferry. He desired to send Slocum's corps and the 10,000 men, composing the garrison at Harper's Ferry, against Lee's rear, but Gen. Halleck, commander-in-chief, refused the request for the garrison, and Hooker asked relief from command. His request was promptly granted, and 28 June Gen. George G. Meade was assigned to the command. Halleck granted Meade's request to utilize the garrison at Harper's Ferry and Meade ordered the abandonment of the place and the transfer of the garrison to Frederick and Washington.

Lee, deprived of the use of his cavalry, had been unable to get information of Hooker's movements; and to retain him on the east side of the mountains, after he had entered Maryland, Ewell had been instructed, on the 24th, to send a division across the South Mountain to threaten Baltimore. Early's division, detailed for the purpose, went as far east as York, the other two divisions of the corps marching from Chambersburg to Carlisle. Jenkins' and White's cavalry were in advance at Wrightsville and above on the Susquehanna, threatening to cross and take Harrisburg. Lee now made preparations to advance upon Harrisburg, but, on the night of the 28th received information that the Union army had crossed the Potomac and was moving northward, its head of column already at South Mountain. His communications thus menaced, Lee resolved to prevent the further progress of the Union army by concentrating his own on the east side of the mountains; accordingly Ewell was ordered to turn back from the Susquehanna, Carlisle, and York, and march for Gettysburg, and Longstreet and Hill were directed to march from Chambersburg to the same place. On the night of the 30th Rodes' division of Ewell's corps was at Heidlersburg, eight miles northeast of Gettysburg, with Early's and Johnson's divisions near. Hill was at Fayetteville and Cashtown, eight miles from Gettysburg, and Longstreet was still at Chambersburg.

On the morning of the 29th under the impression that all of Lee's army was along the Susquehanna, Meade marched by three divergent roads in that direction and on the night of the 30th his forces were thus distributed. Buford, with two brigades of cavalry, was in advance at Gettysburg; Reynolds' First corps on Marsh Creek, five miles southwest of Gettysburg; Sickles' Third corps at Taneytown, and Howard's Eleventh corps at Emmitsburg. These three corps, constituting the left wing of the army, were under command of Gen. Reynolds. Hancock's Second corps was at Uniontown; Sykes' Fifth corps at Union Mills; Sedgwick's Sixth corps at Manchester; and Slocum's Twelfth corps at Littlestown. Gregg's cavalry division was at Westminster. Kilpatrick's division, after a spirited fight with Stuart's cavalry at Hanover, bivouacked near that place. When Buford reached Gettysburg he went into camp just beyond the western limits of the town and threw out skirmishers three miles west and north.

The First Day's Battle.— Heth's division, the advance of Hill's corps, moved from Cashtown at 5 o'clock on the morning of 1 July, coming in sight of Buford's skirmishers about 9 o'clock, at which hour Buford fired his first gun as a signal for his skirmishers to open fire, and the battle of Gettysburg began. Heth advanced and Buford was slowly driven back, contesting every foot of ground, until Reynolds came up with Wadsworth's division, which became immediately and desperately engaged. During this encounter Reynolds was killed. Doubleday succeeding to the command of the First corps, continued the contest. The other two divisions of the corps came up at 11 o'clock, followed at 12.45 by Howard's corps, one division of which was placed in reserve on Cemetery Hill, the other two forming on Doubleday's right along Seminary Ridge. Meanwhile Hill had arrived with the remainder of his corps, and Ewell, arriving at 2.30 P.M. with Rodes' and Early's divisions, formed on Hill's left. Hill made successive assaults on Doubleday from the west, and Ewell upon Howard from the north, which were repulsed; but finally, after desperate fighting and great losses on both sides, Early struck Howard in flank, causing him to give way, and the entire Union line was driven back through the town to Cemetery Hill, about half a mile south, which had been chosen by Howard as a rallying point for the two corps, and upon which he had placed one of his own divisions. When Meade heard that Lee's advance had reached Gettysburg, and that Reynolds had been killed, he was at Taneytown, 14 miles away, preparing to take up a defensive line along Pipe Creek. He ordered Hancock to ride forward and take command at Gettysburg. Hancock arrived as the Union troops were retreating through the town, was struck with the advantages presented by Cemetery Ridge for a defensive battle, determined to hold it and so notified Meade, sent one of Doubleday's small brigades to hold Culp's Hill, on the right, and made an ostentatious display of Buford's cavalry on the extreme left: which show of force, and the great loss — over 7,000 — sustained by the Confederates during the day, caused Lee to defer operations. Two divisions of Sickles' corps came up at dark; Slocum's corps came about the same time, and Slocum, as ranking officer, assumed command of the field, Hancock riding back to report to Meade that Gettysburg — to which point Meade had already ordered the concentration of his army — was the proper place to fight a battle. Hill's and Ewell's

ENTRANCE TO NATIONAL CEMETERY, GETTYSBURG, PA.

NEW YORK STATE MONUMENT IN NATIONAL CEMETERY, GETTYSBURG, PA.

Confederate corps were all up by night, and Longstreet bivouacked four miles in rear of Hill.

The Second Day.— Gen. Meade arrived on the field at 1 o'clock on the morning of the 2d. All his troops except the Sixth corps were up by noon. The Sixth corps, having 34 miles to march from Manchester, did not come up until between 2 and 4 o'clock in the afternoon. The position on which Meade disposed his army was in the shape of a fishhook. As finally posted, the Twelfth corps was on the right at Culp's Hill, facing east; Wadsworth's division on its left, facing north; the Eleventh corps on Cemetery Hill, on the left of Wadsworth, its right facing northeast, its centre and left facing northwest, with Robinson's division of the First corps on its left. Doubleday's division in reserve. The Second corps, facing west, was on the left of Robinson; the Third corps on the left of the Second, with the Fifth, later in the day, on the extreme left. The Sixth corps was in rear of Round Top, on the left, as a reserve. Sickles, not satisfied with the position assigned the Third corps, moved to the front about three fourths of a mile, from where Meade would have recalled him, but it was too late to do so in presence of a vigilant enemy.

The main part of Lee's army was on Seminary Ridge, a short mile west of Meade's left and centre; Longstreet on the right, with Hill on his left. Ewell's corps on the left held the town, and was at right angles to Hill and Longstreet. Pickett's division of Longstreet's corps had not come up. Skirmishing began in the morning. At 4 o'clock in the afternoon the battle opened by Longstreet's advance. He attacked Sickes with great fury and, although reinforced by Caldwell's division of the Second corps, and Barnes' and Ayres' divisions of the Fifth, after heavy fighting and great losses the Third corps and its supports were driven back beyond the main line. Longstreet followed, but was checked by a charge of Crawford's division of the Fifth corps and the firm and solid appearance of the Sixth corps. On Longstreet's right Hood's division advanced to seize Round Top, but was repulsed by Vincent's and Weed's brigades of the Fifth corps. Vincent and Weed were killed, and Hood wounded. During the latter part of Longstreet's engagement with Sickles two of Hill's brigades assailed Hancock's line and broke it, but were soon driven back. At about the same time Hays' and Hoke's brigades of Early's division assaulted Howard's line on Cemetery Hill, but were driven back with the assistance of two regiments and Carroll's brigade of Hancock's corps. Still further on the Confederate left Johnson's division of Ewell's corps assaulted Culp's Hill, then held by Wadsworth's division of the First corps and Greene's small brigade of the Twelfth corps, the rest of the corps having been withdrawn and sent to the assistance of the left. Johnson's right, continuing the fight until late in the night, was repulsed, but his left entered, unopposed, the strong works thrown up by the Twelfth corps, and was perilously near the practically unguarded reserve artillery and ammunition train of the Army of the Potomac. Upon the return of the Twelfth corps during the night to its former position, finding it occupied, it waited until daylight before attempting to retake it. Meanwhile Johnson was being reinforced by three brigades, that he might hold his ground and renew his fight.

The Third Day.— The battle of the third day began by a struggle of the Twelfth corps to regain their works. At 4 A.M. the corps artillery, five batteries, opened a furious fire upon Johnson, at a range of 600 to 800 yards, other batteries followed, in the midst of which Johnson attacked the left of the Twelfth corps and the right of Wadsworth's division; the combat extended to the right, was taken up by Williams' division, and for six hours the struggle continued, at the end of which Johnson was repulsed. At 10.25 Johnson massed his forces in column of regiments and made a determined assault upon the right of Geary's division, by which, with the assistance of Shaler's brigade, he was repulsed, and driven beyond Rock Creek with a loss of nearly 2,000 killed and wounded, and three colors. At 11 o'clock the battle ceased on the Union right, with the Twelfth corps line fully re-established. There was more spectacular fighting on other parts of the field, but none more desperate and bloody than on the wooded Culp's Hill. Meanwhile Lee was preparing an attack upon the left centre of Meade's army. Pickett's division had now come up, and Longstreet was directed to form a column of assault composed of Pickett's division, Pettigrew's division, and two brigades of Pender's division, under Trimble, of Hill's corps. To prevent Meade from reinforcing the threatened point, Stuart's cavalry was ordered to go around Meade's right and attack his rear; 135 guns were disposed on Seminary Ridge; and at 1 P.M. the signal-gun was fired, and the 135 guns opened fire to crush out all opposition at the point to be attacked; the fire was replied to by 85 Union guns, and for two hours the hills shook and the earth trembled. As soon as the Union fire slackened, the great column of attack moved forward, Pickett's division on the right and Pettigrew's on the left. Pettigrew was supported by the two brigades of Trimble, and Pickett by the brigades of Wilcox and Perry. Pickett and Pettigrew, at the start from Seminary Ridge, covered a front of 1,600 yards; they had 1,400 yards of open ground to traverse before reaching the Union line; and the assaulting column numbered 14,000 men. As soon as it started, the Union artillery opened on it with shot and shell, tearing great gaps in the line; as it came nearer, canister did its deadly work; it was attacked on both flanks; and as it approached the Union line, held by Gibbons' and Hays' divisions of Hancock's corps, a flame of musketry burst forth before which nothing could live, and the men began to retreat; but, on the right, Armistead, commanding one of Pickett's brigades, broke the Union line and, with less than 100 men, crossed the Union works and seized a gun; a short hand-to-hand encounter ensued; Armistead was killed, and his small party killed or captured. Pickett saw the failure of his assault, and ordered a general retreat, after losing over 5,000 men. Wilcox's and Perry's brigades, which should have supported Pickett's right, were not prompt in starting, became separated from it and, attacking the right of the First corps, were driven back, los-

ing many prisoners, and the battle of Gettysburg was ended. On the Union right Gregg's cavalry division, aided by Custer's brigade, defeated Stuart, after a severe fight, and thwarted his attempt on Meade's right and rear. On the left Kilpatrick, with two cavalry brigades, recklessly charged Confederate infantry in dense woods, and behind stone fences, west of Round Top, in which assault Gen. Farnsworth, commanding one of his brigades, was killed. On the morning of 4 July Lee withdrew from his advanced positions, put his trains in motion for the rear, retreated at night and; followed and harassed by the Union cavalry, reached Williamsport on the 7th; but as the pontoon bridges had been destroyed and the Potomac had risen, he was unable to cross, and so entrenched. Meade followed by a circuitous route through Frederick and, after some delay, again confronted Lee on the 13th. He was about to attack when Lee recrossed the Potomac on the night of the 14th, his rear-guard, under Gen. Pettigrew, being attacked by Kilpatrick, during which fight Pettigrew was mortally wounded and many prisoners were taken.

From first to last the Union forces on the field numbered about 88,000 effective men; the Confederate forces on the field numbered about 73,000 men. As officially reported, the Union loss was 3,072 killed, 14,497 wounded, and 5,434 missing; an aggregate of 23,003; the Confederate loss 2,592 killed, 12,709 wounded, and 5,150 missing; an aggregate of 20,451. Consult: 'Official Records,' Vol. XXVII.; Compte de Paris, 'The Battle of Gettysburg'; Bates, 'Battle of Gettysburg'; Doubleday, 'Chancellorsville and Gettysburg'; Walker, 'History of the Second Army Corps'; Powell, 'History of the Fifth Army Corps'; The Century Company's, 'Battles and Leaders of the Civil War.'

E. A. Carman.

Geulincx, hė'lĭnks or zhė-läṅks, **Arnold**, Dutch philosopher: b. Antwerp, 1625; d. Leyden 1669. He was one of the disciples of Descartes (q.v.), and a leading exponent of the speculative doctrine known as Occasionalism. For 12 years, from 1646, he lectured successfully at Louvain, was then deposed for some reason not ascertained, and, after living at Leyden in great distress, was in 1665 appointed professor of philosophy there, but died four years later. His ideas are expounded in books entitled: 'Saturnalia'; 'Logica'; 'Ethica,' published in his lifetime, and in 'Annotata præcurrentia ad Cartesii Principia' (1690), and 'Metaphysica Vera' (1691), which appeared after his death. The salient point of his teaching is an endeavor to explain the relations which obtain between soul and body, the mutual interaction of which under stimulus he ascribed to divine intervention and preordained arrangement. See Grimm, 'Arnold Geulincx'; 'Erkenntnisstheorie und Occasionalismus' (1875); Pfleiderer, 'Arnold Geulincx als Hauptvertreter der Occasionalistischen Metaphysik und Ethik' (1882).

Geum, jē'ŭm, a genus of *Rosaceæ*, sub-order *Potentilleæ*, distinguished from *Potentilla* by the hardened hooked styles which crown the carpels, so that the fruit becomes a burr. They are perennial herbs with pinnate or pinnatifid leaves, and white, yellow or purple flowers. There are about 40 species, 14 being found in North America. They are commonly known as avens. The roots of *G. rivale*, purple or white avens, and of *G. urbanum* have astringent and tonic properties. The latter is used for flavoring ale. *Geum strictum* is known as chocolate-root. Many of the species are cultivated, *G. chiloense* being especially ornamental.

Geyserite, gē'sėr-īt, or **Siliceous Sinter**, is amorphous silica containing a varying amount of water. It is white or grayish in color, and is deposited about the geysers and hot springs of Wyoming, Montana, Iceland, and New Zealand as hard masses or in filamentous or cauliflower-like forms sometimes of great beauty. In the Upper Geyser Basin in the Yellowstone Park the formations of geyserite are abundant and most beautiful. The great terraces of the Mammoth Hot Springs are not geyserite, but are chiefly calcareous deposits.

Geysers, a name derived from an Icelandic word signifying "to burst forth with violence," and applied to natural springs of hot water of the kind that were first observed in Iceland, and since in Wyoming and California in the United States, and in New Zealand. They may be described as volcanoes of hot water, for they resemble volcanoes in every particular — in the vibrations of the earth and dull rumbling sounds or loud reports by which the eruptions are preceded, in the intermittence of the phenomenon, and in the form of the opening at which the eruptions take place, like an inverted cone with a deep central throat. Natural philosophers are not agreed as to the mode in which this phenomenon is to be explained, but the most generally prevailing and most probable hypothesis is that it is caused by the disengagement of large quantities of vapor, which force the water up into the air when the successive disengagements have produced a sufficient pressure.

The geysers of Iceland lie about 30 miles west of Mount Hecla, and 16 miles north of the town of Skalholt, in a plain covered by hot-springs and steaming apertures. They are nearly 100 in number, and are scattered over a surface scarcely more than two square miles in extent. The two most remarkable are the Grand Geyser and the New Geyser or *Strokkur* (churn). The Great Geyser rises from a tunnel-shaped basin, lined and edged with silicious deposits. The pipe or throat at the bottom, from which the jet issues, is about 10 feet in diameter, and the basin at its outer edge is above 70. The emissions generally take place at intervals of six hours, and last for about five minutes at a time. The column, as measured by a quadrant, has been seen to rise as high as 212 feet. It is impossible to fix the age of the Great Geyser, but that its eruptions have taken place from the most remote antiquity is proved by the fact that, although there has been no sensible increase in the depth of the silicious deposit since the earliest recorded observations, it is now more than 16 feet deep.

The geysers of Iceland, long the only ones known to exist, are surpassed by those which have been discovered in comparatively recent times in the Yellowstone National Park. The largest of them is called the Grand Geyser. It begins an eruption by filling its basin with boiling water, forming a well 20 by 25 feet in diametric measurements, and having a visible depth, when quiet, of 100 feet. The explosion is preceded by clouds of steam rushing up to a height

OLD FAITHFUL GEYSER, IN YELLOWSTONE PARK.

of 500 feet; the great unbroken body of water succeeds, ascending in one gigantic column to a height of 90 feet; while from the apex of the column there radiate five great jets, which shoot up to the unparalleled height of 250 feet from the ground. Among the other remarkable geysers of this district are those named Old Faithful, the Beehive, the Giant, the Giantess, etc. The number of hot-springs in the Yellowstone is not less than 1,500, all varying in times of action, force, deposits, and color of water.

Ghaleb, gä-lēb', the last of the great poets of the old Turkish school. His 'Husn-u-Ashk' (Beauty and Love), written about 1800, has been called one of the finest productions of Ottoman genius.

Ghavial, găv'ĭ-al. See GAVIAL.

Ghee, gē, or **Ghi**, a peculiar kind of butter in use among the Hindus. It is made in the following manner: The milk when brought from the cow is poured into earthen vessels, in which it is boiled for one hour, often for two or three hours. It is then put in a cool place, and a little curdled milk is added. By the next morning the whole is converted into sour curdled milk. A layer 5 or 6 inches deep is then taken off the top of the contents of each vessel, and is put into another larger vessel, in which the whole mass is gently stirred for half an hour with a split bamboo-cane. A little warm water is then added, and the stirring is continued for another half-hour, when the butter begins to form. After being kept for three days — a period long enough for the butter to become rancid in so hot a climate — it is melted in another earthen vessel, and boiled until all the water it contains is evaporated. A little more curdled milk is then added, along with some salt or betel-leaves, and the butter, which is now ready, is then put in pots, in which it is kept till required. In this state it will keep for a long time, being sometimes used a year after it is made. This butter has naturally a very strong taste, insupportable to a European stomach, but it is in general use among the Hindus who are rich enough to buy it, and is an important article of commerce.

Ghent, gĕnt, Belgium (French, Gand; Flemish, Gend or Gent, capital of the province of East Flanders, at the confluence of the Lys with the Scheldt. It is upward of six miles in circumference, and is divided by canals into a number of islands connected with each other by bridges. Except in some of the older parts, it is well built, and has a number of fine promenades and many notable buildings. Among the latter are the cathedral of St. Bavon, dating from the 13th century; the church of St. Nicholas, the oldest in Ghent; the church of St. Michael, with a celebrated Crucifixion by Van Dyck; the university, a handsome modern structure, with a library of about 100,000 volumes and 700 manuscripts; the belfry, a lofty square tower surmounted by a gilded dragon, and containing chimes of 44 bells; the Marché du Vendredi, an extensive square, interesting as the scene of many important historical events; and Les Béguinages, extensive nunneries founded in the 13th century, the principal occupation of whose members is lace-making. Ghent has long been celebrated as a manufacturing town, especially for its cotton and linen goods and lace. Other industries of importance are sugar-refining, hosiery, thread, ribbons, instruments in steel, carriages, paper, hats, delftware, and tobacco. There are also machine works, engine factories, roperies, tanneries, breweries, and distilleries. The trade is very important. A canal connects it with the Scheldt at Terneuzen. Another canal connects the Lys with the canal from Bruges to Ostend. Ghent was mentioned as a town in the 7th century. In the 9th century Baldwin, the first Count of Flanders, built a fortress here against the Normans. Under the counts of Flanders Ghent continued to increase. Two great revolts took place under the leadership of the Van Arteveldes (1338 and 1369) against Burgundy, and again in the 16th century against Charles V., and the citizens of Ghent, besides losing their privileges, had to pay for the erection of a citadel intended to keep them in bondage. In 1792 the Netherlands fell under the power of France, and Ghent became the capital of the department of Escaut (Scheldt). In 1814 it became, along with Flanders, part of the Netherlands, till the separation of Belgium and Holland. Pop. (1900) 160,949.

Ghent, Treaty of (24 Dec. 1814), the treaty which closed the War of 1812. The British advantage was enormous: the war had been discreditable and rather disastrous to America on land, and was half paralyzed by incompetent administration and dissensions among the States; while even the fleet had not maintained its early triumphs; the overthrow of Napoleon had let loose an irresistible army, and had they persevered they might almost have exacted their own terms. But the British were tired of the burdens of a 20-years war, and the ministers were anxious like them to have done with fighting and settle down to peace; and the American privateers and navy were injuring their commerce unbearably. To our good fortune, also, they had the old-fashioned British contempt for American diplomatic ability, and sent third-rate negotiators to Ghent — Lord Gambier, an ex-naval captain, a junior lord of the admiralty, entirely inexperienced in foreign affairs; Henry Goulburn, a young under-secretary of state, narrow and lacking self-control; and William Adams, an unknown lawyer. America, on the other hand, sent some of the strongest men in the country: John Quincy Adams, James A. Bayard, Henry Clay, Jonathan Russell, and Albert Gallatin, men with no superiors in the world in ability, experience, knowledge, and clearness of purpose, and three at least unsurpassed in tenacity of will. In 1813, when Russia offered mediation, Bayard and Gallatin went to St. Petersburg to negotiate, but England refused the offer. Their instructions had included an article against impressment; but as it was notorious that the Napoleonic wars alone made this a practical question, and those were now ended, the government allowed them to waive that point. The British claims at first set up were impossible: the establishment of the boundary fixed by the Indian Treaty of Greenville in 1795 (see GREENVILLE, TREATY OF), as a permanent line beyond which neither party should acquire territory, thus cutting off the entire Northwest from the United States; the cession of the mouth of the Niagara and Sackett's Harbor, in New York, prohibiting the United States from keeping land or naval forces on the Lakes; and allowing free navigation of the Mis-

sissippi to England. Finally the struggle of the entire autumn and early winter ended in this treaty, which was scarcely more than an agreement to cease hostilities and settle the disputed questions at some other time. The questions of impressment, on which the war had been opened; of the extent of the right of blockade; of the American right to fish in British waters; of the British navigation of the Mississippi, and trade with the Indians; of the armaments on the Lakes; of the American claim for British spoliations; all were silently passed over. The treaty, as ratified 17 Feb. 1815, and proclaimed on the 18th, restored the *status quo* of territorial possessions except some islands in Passamaquoddy Bay — public or private property in the surrendered places not to be destroyed or removed, provided a commission to decide on the ownership of the islands above, the matter to be referred to arbitration if they failed to agree; and other commissions to settle the boundaries provided in the Treaty of Paris (1783) — from the St. Croix to the St. Lawrence at lat. 45° N., thence to Lake Superior, and from St. Mary's River to the Lake of the Woods. The last article binds both parties to use their best endeavors to suppress the slave trade.

Ghent, University of, Belgium, founded 1816 by William I., of Holland. In 1820 an old Jesuit college was remodeled for its use. Various other schools have been merged into the university. There are 750 students, over 100 being foreigners. The institution is maintained by the state, which supports a combined library of city and university, containing over 350,000 volumes.

Gherardi, gā-rär'dē, **Bancroft,** American naval officer: b. Jackson, La., 10 Nov. 1832; d. Stratford, Conn., 10 Dec. 1903. He entered the navy in 1846, and was at the Naval Academy in 1852. He was lieutenant on the Lancaster of the Pacific squadron at the commencement of the Civil War, and in 1862 was made lieutenant-commander. During the War he commanded the Chocorua and the Port Royal, being on the latter vessel in the battle of Mobile Bay, in which he was distinguished for bravery and gallantry. He became rear-admiral in 1887; was commandant of the Brooklyn navy yard in 1887; commanded the North Atlantic squadron; and directed the Columbian naval review in New York harbor in 1893. He retired in 1894.

Ghetto, gĕt'ō, **The,** a Jewish quarter in large cities. The ghetto of Rome, instituted in 1556 by Pope Paul IV., was removed in 1885, its demolition having been rendered necessary by the new Tiber embankment. The Ghetto in New York is one of the largest and most densely populated in the world. In a single tenement building are housed as many as 600 persons and a single city block or square contains 3,000 to 5,000 population. The majority of these people are employees of the sweat-shops (q.v.). The population of the New York Ghetto is estimated at 350,000.

Ghibellines, gĭb'ĕ-lĭnz, Italian political party of the 12th to the 15th centuries. On the death of Lothaire II., emperor of Germany, 4 Dec. 1137, Conrad, Duke of Franconia and Lord of Weiblingen (which by corruption became Ghibelline), was elected his successor. His right to the imperial throne was, however, disputed by Henry the Proud, Duke of Saxony and Bavaria, who was in consequence declared an outlaw and shortly afterward died. His adherents transferred their allegiance to his son, Henry the Lion, at that time a boy of 10, and the whole empire was divided into the partisans of Conrad, who assumed the name of Ghibellines, and those of Henry, or the Guelphs. These titles were first used at the battle of Weinsberg in 1140. The strife between the two parties subsided in Germany, but continued in Italy, resulting in war in 1159. The supporters of the popes were termed Guelphs and those of the emperors Ghibellines. Charles of Anjou expelled the Ghibellines from Italy in 1268; but the contest between the two factions continued till the French invasion in 1495 united them against a common enemy.

Ghiberti, Lorenzo, lō-rĕnd'zō gē-bĕr'tē, Italian sculptor: b. Florence about 1378; d. there 1 Dec. 1455. He early learned from his stepfather Bartoluccio, an expert goldsmith, the arts of drawing and modeling, and that of casting metals. He was engaged in painting in fresco at Rimini, in the palace of Prince Pandolfo Malatesta, when the priori of the society of merchants at Florence invited artists to propose models for one of the bronze doors of the baptistry of San Giovanni. The offering up of Isaac was to be executed in gilt bronze, as a specimen of the work. The judges selected the works of Donatello and Ghiberti as the best, but the former voluntarily withdrew his claims, giving the preference to Ghiberti. After 21 years' labor Ghiberti completed the door, and, at the request of the priori, executed a second, after almost as long a period. Michelangelo said of these, that they were worthy of adorning the entrance to paradise. During these 40 years Ghiberti also completed many other important designs, such as the bronze reliquary of St. Zenobius. The dryness of the school of Giotto appears in his early works; the later are in imitation of the Greeks, and are marked by continually increasing vigor and firmness. The reliquary and the baptistery doors of San Giovanni are, to this day, among the finest specimens of art in modern Italy. Ghiberti also executed some excellent paintings on glass for the churches Or-San-Michele and Santa Maria del Fiore. His 'Commentarii,' a work on Florentine art, is still preserved in MS. See Scott, 'Ghiberti and Donatello' (1882).

Ghirlandajo, gēr-län-dä'yō, **Il** (originally **Domenico Bigordi**), Italian painter: b. Florence 1449; d. there 11 Jan. 1494. There were three brothers of this name (Davide, Benedetto, and Domenico) among Italian artists of the 15th century, and Domenico was the greatest of the three. He was thoroughly original and independent in his style and while he lived just after Masaccio and just before Michelangelo, he was distinct from either. He was skilful in portraiture and his large frescoes of religious subjects are historically interesting from the fact that he introduced as spectators of the incidents portrayed the figures of distinguished Florentines of his day. His great fresco of 'The Calling of Peter and Andrew' in the Sistine Chapel at Rome is much admired, and in his 'Last Supper' at Papiguano he has introduced the portrait of Amerigo Vespucci. His finest work is the 'History of St. Francis' in the Church of The Trinity at Florence. He was also a skilful worker in mosaics, which he called "painting for eternity."

He died of the plague in his 45th year and was buried in Sta. Maria Novella, in Florence.

Ghost Dance, a religious ceremony which originated among the Piute Indians in Nevada about 1889, so named from the fact that the dancers wear a white robe over their ordinary dress. It was the outcome of a religious belief which maintained that a messiah was soon to appear, who would rid the land of the white man and restore to the Indians all their rights. A Piute Indian named Wikova and known among the whites as "Jack Wilson," claimed to be this savior and obtained a marvelous influence over not only his own tribes but those of the surrounding country, who sent their chiefs to listen to his teachings. These were very much in the same line as those of modern Spiritualists, he promising to procure them communication with the spirits of deceased friends. He advocated peace and refused to allow any references in their ceremonies to warlike subjects. The ghost dance is held at night, men and women joining hands and circling around, singing the ghost songs, which are principally chants in the form of messages from their spirit friends. Sometimes the participants appear to fall into a trance, during which they are supposed to commune with residents of the other world. The Sioux outbreak of 1890–1 was due indirectly to the ceremonies of this dance and the United States government sought to suppress it. Since that time no trouble has arisen, though it is still practised by the Indians. See INDIANS.

Ghost-moth, a British nocturnal swift-moth (*Hepialus humuli*), so called from the male being white and hovering in the twilight over one spot (often in churchyards), where the female, which has gray posterior wings and red-spotted anterior wings, is concealed. The caterpillar feeds on the hop and allied plants, and often does considerable damage to the first-named. See SWIFT-MOTHS.

Ghosts. The belief that the spirits of the departed are occasionally presented to the sight of the living, has existed in all ages and countries, and usually declines only when a people has advanced considerably in the knowledge of physical conditions and laws. We can understand the inability of the primitive man and the savage to realize death. The memory of the deceased lends power to call up his appearance. The primitive man does not observe accurately the distinction between fact and fancy — between what is seen in dream and what is seen in reality. (See DREAMS.) The belief that man has a soul capable of existing apart from the body it belongs to, and continuing to live, for a time at least, after that body is dead and buried, fits perfectly in such a mind with the fact that the shadowy forms of men and women do appear to others, when the men and women themselves are at a distance, and after they are dead. We call these apparitions dreams or phantasms, according as the person to whom they appear is asleep or awake; and when we hear of their occurrence in ordinary life, set them down as subjective processes of the mind. Among the less civilized races, the separation of subjective and objective impressions, which in this, as in several other matters, makes the most important difference between the educated man and the savage, is much less fully carried out. The Dyaks regard dreams as actual occurrences; and many savage races believe that dreams are incidents which happen to the spirit when it is wandering from the body. In sleep, the soul is supposed to leave the body and travel about. The man who fancies he sees at night the figure of a friend, or of an enemy, supposes he sees this dreamer's wandering soul. Among primitive races there is a superstitious objection to rousing a sleeper, lest he should awake before his soul has had time to return to the body. Death is regarded as another form of sleep; and during that sleep the spirit is wandering, and when wandering, may be met. See SLEEP.

Witchcraft, necromancy, has always been intimately connected with the spirits of the dead, and this is regarded as the parent of all religious worship. The savage man fears the dead and seeks to propitiate them, and gradually forgets that the ghosts are those of ancestors, and considers them as demons, a separate order of spirits; and later, as he advances in intelligence, these demons cease to be altogether demoniacal, and become gods. Be that as it may, it is certain that the propitiation and even worship of the dead has formed an integral part of all primitive religions, and has maintained its hold among the more ignorant after it has ceased to affect the more educated.

The fear of seeing something often so dazzles and bewilders the visual organ, that it sees the things that were feared. This accounts for many stories of the sight of apparitions in haunted houses. A crime is supposed to have been committed in some old house, and superstition believes that the spirit of the murderer or of the murdered person cannot rest. Whoever is nervous and timid, and visits this house at night, is predisposed to see the wandering spirit, and the fear that is present deprives the judgment of its power of taking accurate observations of what really is seen, and so superinduces a lax condition which is ready to be deceived. There may be conditions of body which allow of a sight beyond what is given to most, as it is certain that beasts see and scent and hear what our own faculties fail to perceive. But what we insist on is, that the greatest caution should be exercised in receiving stories of apparitions, and the utmost care taken to investigate every case of apparent spiritual manifestation. Before we can admit that there are genuine cases of ghosts having been seen, we must be satisfied that the observer was in full possession of his faculties, that his attention was on the alert, that he was capable of judging between subjective and objective presentments, and that he was healthy in mind and body.

In 1882 a Society for Psychical Research was founded in London for the scientific and systematic investigation of reported apparitions, clairvoyance, haunted houses, hypnotism, thought-reading, and spiritualistic phenomena; it publishes regular reports of its investigations.

The subject of ghosts is treated from other and various view points under APPARITIONS, and the reader is also referred to SPIRITUALISM and WITCHCRAFT, and the following works: Brewster, 'Natural Magic' (1832); Ingram, 'Haunted Houses' (1884); Myers, 'Phantasms of the Living' (1886); Owen, 'The Debatable Land' (1874); Stead, 'Real Ghost Stories' (1891).

sissippi to England. Finally the struggle of the entire autumn and early winter ended in this treaty, which was scarcely more than an agreement to cease hostilities and settle the disputed questions at some other time. The questions of impressment, on which the war had been opened; of the extent of the right of blockade; of the American right to fish in British waters; of the British navigation of the Mississippi, and trade with the Indians; of the armaments on the Lakes; of the American claim for British spoliations; all were silently passed over. The treaty, as ratified 17 Feb. 1815, and proclaimed on the 18th, restored the *status quo* of territorial possessions except some islands in Passamaquoddy Bay — public or private property in the surrendered places not to be destroyed or removed, provided a commission to decide on the ownership of the islands above, the matter to be referred to arbitration if they failed to agree; and other commissions to settle the boundaries provided in the Treaty of Paris (1783) — from the St. Croix to the St. Lawrence at lat. 45° N., thence to Lake Superior, and from St. Mary's River to the Lake of the Woods. The last article binds both parties to use their best endeavors to suppress the slave trade.

Ghent, University of, Belgium, founded 1816 by William I., of Holland. In 1820 an old Jesuit college was remodeled for its use. Various other schools have been merged into the university. There are 750 students, over 100 being foreigners. The institution is maintained by the state, which supports a combined library of city and university, containing over 350,000 volumes.

Gherardi, gā-rär'dē, **Bancroft,** American naval officer: b. Jackson, La., 10 Nov. 1832; d. Stratford, Conn., 10 Dec. 1903. He entered the navy in 1846, and was at the Naval Academy in 1852. He was lieutenant on the Lancaster of the Pacific squadron at the commencement of the Civil War, and in 1862 was made lieutenant-commander. During the War he commanded the Chocorua and the Port Royal, being on the latter vessel in the battle of Mobile Bay, in which he was distinguished for bravery and gallantry. He became rear-admiral in 1887; was commandant of the Brooklyn navy yard in 1887; commanded the North Atlantic squadron; and directed the Columbian naval review in New York harbor in 1893. He retired in 1894.

Ghetto, gĕt'ō, **The,** a Jewish quarter in large cities. The ghetto of Rome, instituted in 1556 by Pope Paul IV., was removed in 1885, its demolition having been rendered necessary by the new Tiber embankment. The Ghetto in New York is one of the largest and most densely populated in the world. In a single tenement building are housed as many as 600 persons and a single city block or square contains 3,000 to 5,000 population. The majority of these people are employees of the sweat-shops (q.v.). The population of the New York Ghetto is estimated at 350,000.

Ghibellines, gĭb'ĕ-lĭnz, Italian political party of the 12th to the 15th centuries. On the death of Lothaire II., emperor of Germany, 4 Dec. 1137, Conrad, Duke of Franconia and Lord of Weiblingen (which by corruption became Ghibelline), was elected his successor. His right to the imperial throne was, however, disputed by Henry the Proud, Duke of Saxony and Bavaria, who was in consequence declared an outlaw and shortly afterward died. His adherents transferred their allegiance to his son, Henry the Lion, at that time a boy of 10, and the whole empire was divided into the partisans of Conrad, who assumed the name of Ghibellines, and those of Henry, or the Guelphs. These titles were first used at the battle of Weinsberg in 1140. The strife between the two parties subsided in Germany, but continued in Italy, resulting in war in 1159. The supporters of the popes were termed Guelphs and those of the emperors Ghibellines. Charles of Anjou expelled the Ghibellines from Italy in 1268; but the contest between the two factions continued till the French invasion in 1495 united them against a common enemy.

Ghiberti, Lorenzo, lō-rĕnd'zō gē-bĕr'tē, Italian sculptor: b. Florence about 1378; d. there 1 Dec. 1455. He early learned from his stepfather Bartoluccio, an expert goldsmith, the arts of drawing and modeling, and that of casting metals. He was engaged in painting in fresco at Rimini, in the palace of Prince Pandolfo Malatesta, when the priori of the society of merchants at Florence invited artists to propose models for one of the bronze doors of the baptistry of San Giovanni. The offering up of Isaac was to be executed in gilt bronze, as a specimen of the work. The judges selected the works of Donatello and Ghiberti as the best, but the former voluntarily withdrew his claims, giving the preference to Ghiberti. After 21 years' labor Ghiberti completed the door, and, at the request of the priori, executed a second, after almost as long a period. Michelangelo said of these, that they were worthy of adorning the entrance to paradise. During these 40 years Ghiberti also completed many other important designs, such as the bronze reliquary of St. Zenobius. The dryness of the school of Giotto appears in his early works; the later are in imitation of the Greeks, and are marked by continually increasing vigor and firmness. The reliquary and the baptistery doors of San Giovanni are, to this day, among the finest specimens of art in modern Italy. Ghiberti also executed some excellent paintings on glass for the churches Or-San-Michele and Santa Maria del Fiore. His ‹Commentarii,› a work on Florentine art, is still preserved in MS. See Scott, ‹Ghiberti and Donatello› (1882).

Ghirlandajo, gēr-län-dä'yō, **Il** (originally **Domenico Bigordi**), Italian painter: b. Florence 1449; d. there 11 Jan. 1494. There were three brothers of this name (Davide, Benedetto, and Domenico) among Italian artists of the 15th century, and Domenico was the greatest of the three. He was thoroughly original and independent in his style and while he lived just after Masaccio and just before Michelangelo, he was distinct from either. He was skilful in portraiture and his large frescoes of religious subjects are historically interesting from the fact that he introduced as spectators of the incidents portrayed the figures of distinguished Florentines of his day. His great fresco of ‹The Calling of Peter and Andrew› in the Sistine Chapel at Rome is much admired, and in his ‹Last Supper› at Papiguano he has introduced the portrait of Amerigo Vespucci. His finest work is the ‹History of St. Francis› in the Church of The Trinity at Florence. He was also a skilful worker in mosaics, which he called "painting for eternity."

He died of the plague in his 45th year and was buried in Sta. Maria Novella, in Florence.

Ghost Dance, a religious ceremony which originated among the Piute Indians in Nevada about 1889, so named from the fact that the dancers wear a white robe over their ordinary dress. It was the outcome of a religious belief which maintained that a messiah was soon to appear, who would rid the land of the white man and restore to the Indians all their rights. A Piute Indian named Wikova and known among the whites as "Jack Wilson," claimed to be this savior and obtained a marvelous influence over not only his own tribes but those of the surrounding country, who sent their chiefs to listen to his teachings. These were very much in the same line as those of modern Spiritualists, he promising to procure them communication with the spirits of deceased friends. He advocated peace and refused to allow any references in their ceremonies to warlike subjects. The ghost dance is held at night, men and women joining hands and circling around, singing the ghost songs, which are principally chants in the form of messages from their spirit friends. Sometimes the participants appear to fall into a trance, during which they are supposed to commune with residents of the other world. The Sioux outbreak of 1890–1 was due indirectly to the ceremonies of this dance and the United States government sought to suppress it. Since that time no trouble has arisen, though it is still practised by the Indians. See INDIANS.

Ghost-moth, a British nocturnal swift-moth (*Hepialus humuli*), so called from the male being white and hovering in the twilight over one spot (often in churchyards), where the female, which has gray posterior wings and red-spotted anterior wings, is concealed. The caterpillar feeds on the hop and allied plants, and often does considerable damage to the first-named. See SWIFT-MOTHS.

Ghosts. The belief that the spirits of the departed are occasionally presented to the sight of the living, has existed in all ages and countries, and usually declines only when a people has advanced considerably in the knowledge of physical conditions and laws. We can understand the inability of the primitive man and the savage to realize death. The memory of the deceased lends power to call up his appearance. The primitive man does not observe accurately the distinction between fact and fancy — between what is seen in dream and what is seen in reality. (See DREAMS.) The belief that man has a soul capable of existing apart from the body it belongs to, and continuing to live, for a time at least, after that body is dead and buried, fits perfectly in such a mind with the fact that the shadowy forms of men and women do appear to others, when the men and women themselves are at a distance, and after they are dead. We call these apparitions dreams or phantasms, according as the person to whom they appear is asleep or awake; and when we hear of their occurrence in ordinary life, set them down as subjective processes of the mind. Among the less civilized races, the separation of subjective and objective impressions, which in this, as in several other matters, makes the most important difference between the educated man and the savage, is much less fully carried out. The Dyaks regard dreams as actual occurrences; and many savage races believe that dreams are incidents which happen to the spirit when it is wandering from the body. In sleep, the soul is supposed to leave the body and travel about. The man who fancies he sees at night the figure of a friend, or of an enemy, supposes he sees this dreamer's wandering soul. Among primitive races there is a superstitious objection to rousing a sleeper, lest he should awake before his soul has had time to return to the body. Death is regarded as another form of sleep; and during that sleep the spirit is wandering, and when wandering, may be met. See SLEEP.

Witchcraft, necromancy, has always been intimately connected with the spirits of the dead, and this is regarded as the parent of all religious worship. The savage man fears the dead and seeks to propitiate them, and gradually forgets that the ghosts are those of ancestors, and considers them as demons, a separate order of spirits; and later, as he advances in intelligence, these demons cease to be altogether demoniacal, and become gods. Be that as it may, it is certain that the propitiation and even worship of the dead has formed an integral part of all primitive religions, and has maintained its hold among the more ignorant after it has ceased to affect the more educated.

The fear of seeing something often so dazzles and bewilders the visual organ, that it sees the things that were feared. This accounts for many stories of the sight of apparitions in haunted houses. A crime is supposed to have been committed in some old house, and superstition believes that the spirit of the murderer or of the murdered person cannot rest. Whoever is nervous and timid, and visits this house at night, is predisposed to see the wandering spirit, and the fear that is present deprives the judgment of its power of taking accurate observations of what really is seen, and so superinduces a lax condition which is ready to be deceived. There may be conditions of body which allow of a sight beyond what is given to most, as it is certain that beasts see and scent and hear what our own faculties fail to perceive. But what we insist on is, that the greatest caution should be exercised in receiving stories of apparitions, and the utmost care taken to investigate every case of apparent spiritual manifestation. Before we can admit that there are genuine cases of ghosts having been seen, we must be satisfied that the observer was in full possession of his faculties, that his attention was on the alert, that he was capable of judging between subjective and objective presentments, and that he was healthy in mind and body.

In 1882 a Society for Psychical Research was founded in London for the scientific and systematic investigation of reported apparitions, clairvoyance, haunted houses, hypnotism, thought-reading, and spiritualistic phenomena; it publishes regular reports of its investigations.

The subject of ghosts is treated from other and various view points under APPARITIONS, and the reader is also referred to SPIRITUALISM and WITCHCRAFT, and the following works: Brewster, 'Natural Magic' (1832); Ingram, 'Haunted Houses' (1884); Myers, 'Phantasms of the Living' (1886); Owen, 'The Debatable Land' (1874); Stead, 'Real Ghost Stories' (1891).

Ghosts, a powerful play by Henrik Ibsen (1881), giving dramatic embodiment to the modern realization of heredity. Ibsen, treating this subject on its tragic side, considers the case of the darker passions as they are handed down from father to son. It is a Greek tragedy translated into the littleness and barrenness of modern life. 'Ghosts' is perhaps the most remarkable of Ibsen's dramas in its searching judgment, its recognition of terrible fact, its logical following of the merciless logic of nature.

Ghuri, goo'rē, an Asiatic dynasty who had the seat of their empire in the country of Ghur, and ruled over Persia, Afghanistan, northern Hindustan, and Transoxiana. Ghur first appears in history in connection with Mahmud of Ghazni and his son Masaud, the latter of whom subjugated the region in 1020. About a century later Malik Izzuddin made himself ruler of all the Ghur country. His son, Alauddin Jahansoz (the Burner), fell upon Ghazni, and burned it to the ground. This prince's nephews, Ghiyassuddin and Muizuddin, established their power in Khorasan and Ghazni. The latter, crossing the Indus, then conquered successively the provinces of Multan (1176), Lahore (1186), and Ajmere (1190), and, in the course of the next six years all Hindustan as far south as Nagpur and east to the Irawaddy. On the death of Muizzuddin the Indian states asserted their independence, the power of the Ghuri being confined to Ghur, Seistan, and Herât. This last feeble remnant was taken from them by the Shah of Kharezm about 1215. Some 30 years later the Ghur princes managed to revive something of their former power at Herât, which they retained by sufferance from the Mongols down to 1383, when the city was captured by Timur, and the Ghur sovereignty came to an end.

Ghurkas, goor'kaz, **Gurkahs,** or **Goorkhas,** a tribe of northern India, named from the village of Ghurkas in Nepal, formerly the capital of the Ghurkas, before the formation of the present kingdom of Nepal. The Ghurkas are the mountaineers of Nepal, and speak a Sanskritic language. The Mohammedans drove them out of Rajputana, and they migrated to Nepal, of which they took possession in 1768. When the English first invaded India, the Ghurkas were formidable opponents, but are now most friendly. A large number of them are in the Anglo-Indian army, chiefly in the infantry, as they have no regard for the cavalry service. Besides their rifle they carry a formidable short-bent sword called a koorkree, with the edge on the inside of the bend, with which at close quarters they do dreadful execution. See Nepal.

Giacomotti, Félix Henri, fā-lěks ǒn-rē zhä-kō-mō-tē, French artist: b. Quingey, Doubs, 19 Nov. 1828. He was a pupil of Picot at the Beaux-Arts, Paris; obtained the Grand Prix de Rome in 1854; established his studio at Paris in 1861, and painted numerous subjects from mythology, religious works, and portraits. Among his canvases are: 'Centaur and Nymph'; 'Christ Teaching in the Temple'; 'The Mount of Calvary.' He also executed a fresco for the ceiling of one of the salons of the Luxembourg representing the apotheosis of Rubens and painting.

Giant Cells, in pathology, a form of large cells many times the size of the cells of the body with which they are associated. They very frequently have a large number of nuclei, sometimes as many as 100 or more. It is supposed that giant cells originate from a lack of cell-division, rather than by a coalescence of a number of small cells. Many giant cells are found in the neighborhood of active growing tissue, associated with infectious disease processes, such as tuberculosis and carcinoma. It is thought that the function of giant cells is protective.

Giants, people of extraordinary stature. History, both sacred and profane, makes mention of giants. The first mention of giants in the Bible is in Gen. vi. 4, where the Hebrew word used is *nephilim*, a word which occurs in only one other passage, where it is applied to the sons of Anak, who dwelt about Hebron, and who were described by the terrified spies as of such size that compared with them they appeared in their own sight as grasshoppers. A race of giants called the Rephaim is frequently mentioned in the Bible. In Gen. xiv. 5, and xv. 20, they appear as a distinct tribe, holding possessions in Canaan. At the period of the conquest of Canaan, Og, king of Bashan, who had a bedstead 9 cubits long, is said to have remained alone of this tribe, but this must be taken to mean alone on the east side of Jordan; for giants, who were probably of the same stock, are subsequently mentioned as living about Mount Ephraim (Jos. xvii. 15) and among the Philistines (2 Sam. xxi. 18). Goliath, who measured 6 cubits and a span, and who was slain by David, is the most celebrated of the giants mentioned as living among the Philistines. The other races of giants who are mentioned in the Bible (besides the sons of Anak already referred to) are the Emim, who occupied the country afterward held by the Moabites, and the Zuzim (a branch of the Rephaim), who lived on the east side of the Jordan, between the Arnon and the Jabbok. In Deut. ii. 20 they are said to have been called by the Ammonites, who conquered them, Zamzummim.

The giants of Greek mythology are believed by some to represent the struggle of the elements of nature against the gods, that is, against the order of creation. They were said to have sprung from the blood of Uranus, which fell into the lap of Ge (the earth). Their mother, indignant at the banishment of the Titans into Tartarus, excited them to revolt against the gods. They hurled mountains and forests against Olympus, disdaining the lightnings of Zeus. An oracle having declared that the gods could not conquer except by the assistance of a mortal, Athene called Heracles to their aid. He slew Alcyoneus and Porphyrion, the most formidable of the giants. Apollo and Heracles shot out the eyes of Ephialtes; Dionysus slew Eurytus with his thyrsus; Hecate and Hephæstus killed Clytius with clubs of hot iron; Poseidon hurled a part of the island of Cos on Polybotes; Athene buried Enceladus under the island of Sicily, and flayed Pallas, and made a shield of his skin. The remainder perished under the hands of other deities by the thunderbolts of Jupiter or the arrows of Heracles. This fable perhaps indicates volcanic eruptions, for which the Phlegræan fields, where the chief scene of this struggle is placed, and where the two principal giants were born, were remarkable. Cos and Sicily, which figure in this fable, are also volcanic. Ovid has

described the war of the giants in the beginning of his 'Metamorphoses.'

Giants figure rather largely in Celtic and Scandinavian mythology and legends. In the legends of the Irish there are the two giants, Fingall or Finn MacCumhal and his son Ossian. The giants of the Welsh are familiar to every one through the achievements of Jack the Giant Killer, the representative of the Scandinavian Thor, the destroyer of Skrimmer, and the Swiss giants.

The following are regarded as authentic instances of giant stature: In the time of Augustus there were to be seen in the Horti Sallustiani at Rome, the bodies of a giant, Posio, and a giantess, Secundilla, each 10 feet 3 inches high. In the reign of Claudius, an Arabian giant named Gabbaras, 9 feet 4 inches high, was exhibited at Rome. The Emperor Maximin, a Thracian, was nearly 9 feet high. A Jewish giant, about 10 feet high, is mentioned by Josephus. Long Mores, an Irish giant, of the time of Edward III., was 6 feet 10½ inches high. Queen Elizabeth's Flemish porter was 7 feet 0 inches: and J. Middleton, or the Child of Hale, born in 1578, attained the height of 9 feet 3 inches. C. Munster, a yeoman of the guard in Hanover, who died in 1676, was 8 feet 6 inches high; and Cajanus, a Swedish giant, about 9 feet high, exhibited in London in 1742. C. Byrne, who died in 1783, attained the height of 8 feet 4 inches; and Patrick Cotter O'Brien, a native of Kinsale, who lived about the same time, was 8 feet 7¼ inches. In 1884 died Pauline Wedde (called Marian), a German giantess, over 8 feet 2 inches at the age of 18; and in 1887 Josef Winkelmaier, an Austrian, 8 feet 9 inches, aged 22. Anna Swan, a native of Nova Scotia, above 8 feet high; her husband, Capt. Bates, a native of Kentucky, of the same height; Chang-wu-gon, the Chinese giant, 7 feet 9 inches high; and Feodor Machow, a Russian, 7 feet 9 inches, who as late as 1900 were living in retirement, after many years of public exhibition.

Giant's Causeway, Ireland (deriving its name from a legend that it was the commencement of a road to be constructed by giants across the channel to Scotland), a natural pier or mole of columnar basalt, projecting from the north coast of Antrim, Ireland, into the North Channel, 7 miles northeast of Portrush. It is part of an overlying mass of basalt from 300 to 500 feet in thickness, which covers almost the whole county of Antrim, and the eastern part of Londonderry. It is exposed for 300 yards, and exhibits an unequal pavement, formed of the tops of 40,000 vertical closely fitting polygonal columns, which in shape are chiefly hexagonal. The diameter of the pillars varies from 15 to 20 inches. Each pillar is divided into joints of unequal length, the concave hollow at the end of one division fitting exactly into the convex projection of the other. The rock is compact and homogeneous, and is somewhat sonorous when struck with a hammer. The Giant's Causeway is itself formed of three causeways, the Little, Middle or Honeycomb, and the Grand Causeway. On the Little Causeway may be seen an octagon, pentagon, hexagon, and heptagon all together; on the Middle Causeway is the famous Wishing Chair, with two arms and a back, on a platform where the columns rise to a height of about 10 feet. On the Grand Causeway are pointed out the Lady's Fan, an exact arrangement of five perfect pentagons surrounding a heptagon; the Keystone of the Causeway — a sunk octagon; and the single triangle. At the starting point is the Giant's Loom, an imposing row of columns 30 feet high, each intersected by about 30 joints; to the left is the Giant's Well, to the right the Giant's Chair.

Gibara, gē-bä'rä, Cuba, a seaport on the northern coast of Santiago province. It has a fine harbor protected by a fort at the entrance. There is a military hospital here. Pop. 6,841.

Gibbes, Robert Wilson, American scientist and historian: b. Charleston, S. C., 8 July 1809; d. Columbia, S. C., 15 Oct. 1866. He was graduated from South Carolina College in 1827, from the Medical College of South Carolina in 1830. In 1827–35 was assistant professor of chemistry, geology, and mineralogy in the South Carolina College, and in the Civil War was surgeon-general of South Carolina. His contributions to science appeared in the 'Journal' of the Academy of Natural Science, and other learned publications. His paper on 'Typhoid Pneumonia' ('American Journal of Medical Sciences,' 1842) was the first to urge the substitution of stimulants for the knife in the treatment of that disease. He published: 'Documentary History of the American Revolution' (1853 et. seq.).

Gibbet, jĭb'ĕt, a gallows, formerly in use in Europe, on which the bodies of criminals who had been guilty of particularly atrocious crimes were suspended after execution, encased in an iron frame, near the spot where the crime was committed. This was done for the purpose of striking terror into the evil-minded, and of affording "a comfortable sight to the relations and friends of the deceased." The practice, first recognized by law in Great Britain in 1752, was abolished in 1834.

Gibbon, gĭb'ŏn, **Edward,** English historian: b. Putney, Surrey, 27 April 1737; d. London 16 Jan. 1794. He studied at Westminster and Magdalen College, Oxford. At 17 he became a Roman Catholic, but later, at Lausanne, Switzerland, returned to the Protestant faith. In 1758 he returned to England, and soon after composed his 'Essai sur l'Etude de la Littérature' in the French language, which for some years had been more familiar to him than his own. This work, which was printed in 1761, was a highly respectable juvenile performance, and obtained considerable praise in the foreign journals. After passing months in London he then visited Paris and Lausanne, at which latter place he employed himself in collecting and preparing materials for a profitable journey to Italy. This took place in 1764; and it was at Rome, as he himself informs us, on the 15th of October in that year, as he sat musing among the ruins of the capitol, "while the barefooted friars were singing vespers in the Temple of Jupiter," that his idea of writing the 'Decline and Fall of the Roman Empire' entered his mind. In 1774 he obtained a seat in Parliament for the borough of Liskeard, and was a silent supporter of the North administration and its American politics for eight years. In 1776 the first quarto volume of his 'Decline and Fall of the Roman Empire' appeared, and at once riveted general attention, the first edition going off in a few days, and a second and a third being scarcely equal to the

demand. Of all the applause he received none seemed to flatter him so much as the spontaneous suffrages of Hume and Robertson. The progress of his history was for some time delayed by his complying with the request of ministers to answer a manifesto which the French court had issued against Great Britain preparatory to war. This he very ably executed in a 'Mémoire Justificatif,' composed in French, which was delivered in a state paper to the courts of Europe; and for this service he received the appointment of one of the lords of trade (1778). In 1781 appeared the second and third volumes of his history. At a new election he lost his seat for Liskeard, but was brought in for the borough of Lymington. On the retirement of the North administration he lost his appointment by the dissolution of the board of trade, and retired to his favorite Lausanne in 1783. Here, in the course of four years, he completed the three remaining volumes of his history, which were published together in April 1788, on the 51st anniversary of the author's birthday. The storms of the French Revolution, which he regarded from the first with fear and aversion, gradually lessened his attachment to Lausanne, and in 1793 he returned to England. In 1796 his friend Lord Sheffield published two quarto volumes of his miscellaneous works, of which the most valuable part is the 'Memoirs,' written with much apparent frankness. Had he lived, Gibbon would doubtless have completed these memoirs; but as they are the simple, straightforward records of a famous student's labors and aims, who by his manly character made many lasting friendships, they form one of the most interesting, brilliant, and suggestive autobiographies in the English language. Gibbon as a historian has gained enduring fame, and up to the present day the universal acknowledgment of the learned world has allowed him the highest rank. The merits and defects of his great history, its elegance and research, as well as its occasional indecency of allusion and its sneers at revealed religion, are too well known to need comment. A good edition of the 'Decline and Fall' is that edited by Milman (1838–9), with the notes of Guizot. An excellent new annotated edition is that of Bury (seven vols., 1896–1900). In 1897 a selection of Gibbon's private letters was published in two volumes, also 'Autobiographies' in one. See Morrison's 'Gibbon' in English Men of Letters series.

Gibbon, John, American soldier: b. Holmesburg, Pa., 1827; d. 1896. He was graduated from the United States Military Academy in 1847, and after service in the Mexican War was assistant instructor in artillery in the Academy 1854–7 and quartermaster 1856–9. He served in the Civil War and became major-general of volunteers and brevet major-general United States army. In 1891 was retired from the service. He published 'The Artillerists' Manual' (1859).

Gibbon, a tailless anthropoid ape of the East Indies, the several species of which constitute the genus *Hylobates* of the family *Simiidæ*. They are nearly allied to the orangs and chimpanzees, but are smaller, of more slender form, and their arms are so long as almost to reach the ground when the animal assumes an erect posture; there are also naked callosities on the buttocks. In general the gibbons are the lowest among the anthropoid apes, and connect them with the Old World monkeys by way of the semnopithecine group. (See LANGUR.) The gibbons are inhabitants of forests, their long arms enabling them to swing themselves from bough to bough, which they do to wonderful distances and with extreme agility. They cannot, however, move with ease or rapidity on the ground. The conformation of the hinder extremities adds to their difficulty in this, while it increases their adaptation to a life among the branches of trees, the soles of the feet being much turned inward. None of the gibbons are of large size, averaging about three feet tall. Eight or ten species are named in the books, but probably increased knowledge will reduce this number. One, the siamang (*H. syndactylus*) has the second and third digits of the hind limb partly united, and the hair of the upper arm pointing downward, while that on the forearm grows upward. It is a native of Sumatra, and has been set apart as the type of a separate genus (*Siamanga*) by some naturalists. The other species have the digits mostly free; they are natives of Cambodia, the Malay Peninsula, Sumatra, and Java, and are known as lars, hoolocks, agile gibbons, white-handed gibbons, etc., but are much alike. One species is called "wow-wow" in imitation of the howling cry that is characteristic of all. Consult Cassell's and the Royal 'Natural Histories,' and Hartmann's 'Anthropoid Apes' (1886).

Gibbons, Abigail (Hopper), American philanthropist: b. Philadelphia 7 Dec. 1801; d. New York 10 Jan. 1893. She was daughter of Isaac T. Hopper (q.v.) and wife of James Sloan Gibbons (q.v.). She taught in Philadelphia and New York, in 1845 assisted in founding the Women's Prison Association, and was also a founder of the Isaac T. Hopper Home for discharged prisoners. In the Civil War she was active in Federal hospitals and camps. It was chiefly through her instrumentality that the New York State reformatory for women and girls was established by the legislature.

Gibbons, Grinling, English sculptor and wood-carver: b. Rotterdam 4 April 1648; d. London 3 Aug. 1721. In 1671 Evelyn found him at Deptford carving on wood Tintoretto's 'Crucifixion'; and on Evelyn's recommendation he was appointed by Charles II. to a place in the Board of Works, and employed in the ornamental carving of the choir of the chapel at Windsor. His works display great taste and delicacy of finish, and his flowers and foliage have almost the lightness of nature. For the choir of St. Paul's, London, he executed the foliage and festoons, and those in lime-tree which decorate the side aisles. At Chatsworth, at Burleigh, at Southwick, Hampshire, and other mansions of the English nobility, he executed an immense quantity of carved embellishment; the ceiling of a room at Petworth is regarded as his *chef d'œuvre*. He also produced several fine pieces in marble and bronze. Among these are the statue of James II., Whitehall; the base of the statue of Charles I., at Charing Cross; and that of Charles II., at the Royal Exchange.

Gibbons, James, American cardinal: b. Baltimore, Md., 23 July 1834. When very young he was taken by his father to Ireland to be educated. He returned to America in 1853 and re-

HIS EMINENCE JAMES, CARDINAL GIBBONS.

sided in New Orleans until 1855, when he matriculated at St. Charles College, near Ellicott City, Md., where he was graduated with distinction in 1857. He then pursued his theological course at the Seminary of St. Sulpice and at St. Mary's University, Baltimore. On 30 June 1861 he was ordained a priest, his first mission being at St. Patrick's Church, Baltimore, where he was assistant. Transferred to St. Bridget's Church, Canton, he ministered to a small congregation till 1865, when Archbishop Spalding made him chancellor of the archdiocese and his private secretary. The second plenary council at Baltimore, 1866, made him its assistant chancellor, and in August 1868 he was consecrated titular bishop of Adramyttum *in partibus infidelium* and first vicar-apostolic of North Carolina, erected by bull of His Holiness, Pius IX., dated 3 March 1868. He found three churches, two priests, and about 1,000 Roman Catholics scattered over the entire State. He opened a school, which he personally conducted; built six churches; introduced into the vicariate the Benedictine order at Belmont, Gaston County, where Mary Help abbey was later erected; established the Sisters of Mercy and built for them a school for whites and one for negroes in Wilmington. He made the personal acquaintance of every adult Roman Catholic in the State, and met them at their homes, traveling from the seaside to the mountains, up and down the State, that none should be neglected. After four years he was translated to the see of Richmond in 1872. Here he erected five churches, St. Peter's Academy in charge of the Xaverian Brothers, and St. Sophia's home for old people in charge of the Little Sisters of the Poor, in Richmond, Va., and parochial schools in Petersburg and Portsmouth, Va.; and enlarged St. Joseph's female orphan asylum, Richmond, Va. In 1877 Archbishop Bayley asked to have Bishop Gibbons appointed his coadjutor, and on the death of Archbishop Bayley in October of that year Bishop Gibbons became archbishop of Baltimore, the highest ecclesiastical dignitary of the Roman Catholic Church in the United States. He headed the delegation of American prelates who visited Rome in 1883 to represent the affairs of the Church in the United States at the Vatican, and to outline the work of the third plenary council, to meet in 1884. Pope Leo XIII. appointed Archbishop Gibbons to preside over the council. In directing the proceedings of the council he co-operated in the enactment of many important new decrees, made necessary by the progress and development of Catholicism in America; and these acts and decrees were, after mature deliberation, approved by the ecclesiastical authorities. Leo XIII. expressed his approval of the action and course of Archbishop Gibbons and created him cardinal 7 June 1886, and on 30 June 1886 Archbishop Kenrick of St. Louis, representing the Pope, bestowed the insignia of his office upon the newly made cardinal. Cardinal Gibbons sailed for Europe the next year to receive the apostolic benediction and to be admitted to membership in the college of cardinals, the 25th in succession. While in Rome he interpreted to the Pope the democratic spirit of American Catholicism in respect to the labor organizations in the United States and the exact relation existing between the employers and the employed. He was installed as pastor of his titular church 25 March 1887, and was assigned to the Church of Santa Maria in Trastevere, a church of great antiquity, on the Tiber. He returned to America in November 1887; on 24 May 1888 laid the cornerstone of the Catholic University, Washington, D. C., and dedicated the divinity building 13 Nov. 1889. Cardinal Gibbons has been chancellor of the University since its foundation. In November 1888 he celebrated at Baltimore the centenary of the founding of the Catholic hierarchy in the United States, subsequently convening a congress of Catholic laymen, the first ever held in the United States. Cardinal Gibbons is president of the Bureau of Catholic Indian Missions, and is the first American cardinal to take part in the election of a pope. A model Churchman, he is also a typical American citizen, loyal, progressive, and public-spirited. He has published: 'The Faith of Our Fathers' (1876; 58th ed. 1903); 'Our Christian Heritage' (1889); 'The Ambassador of Christ' (1896); etc. The archdiocese of Baltimore now (1905) has a Catholic population of 250,000; 396 priests; 261 churches; 95 parochial schools; 3 universities; 2 diocesan seminaries; 6 hospitals, and other charitable and educational institutions.

Gibbons, James Sloane, American banker: b. Wilmington, Del., 1 July 1810; d. New York 17 Oct. 1892. He early became a strong abolitionist, and in 1863 his house in New York was sacked by a mob, during the draft riots, because he had illuminated it in honor of Abraham Lincoln. His fame rests chiefly on his patriotic song, which was very popular during the Civil War, 'We are Coming, Father Abraham, Three Hundred Thousand More.'

Gibbs, Alfred, American soldier: b. Sunswick, L. I., 22 April 1823; d. Fort Leavenworth, Kan., 26 Dec. 1868. He was graduated from the United States Military Academy in 1846, served in the mounted rifles during the Mexican War, was brevetted captain, and until 1861 was employed in frontier and recruiting service. He served in the Federal army during the Civil War and attained the rank of major-general of volunteers and brevet brigadier-general United States Army. He was mustered out of the volunteer service in 1866, became major of the Seventh cavalry in that year, and until his death was stationed at various Kansas forts.

Gibbs, George, American mineralogist: b. Newport, R. I., 8 Jan. 1782; d. Newtown, N. Y., 5 Aug. 1833. Early becoming interested in the study of mineralogy, he collected during his travels in Europe, chiefly by purchase, a very extensive and valuable cabinet of minerals, the most extensive at the time that had been brought together in the United States. This collection he set up in the public rooms of Yale College, where it remained without charge from 1811–25 and in the latter year it was purchased for the college for $20,000.

Gibbs, James Edward Allen, American inventor: b. 1 Aug. 1829; d. Raphine, Rockbridge County, Va., 25 Nov. 1902. While a young man the subject of the sewing-machine was called to his attention, and presently he thought out the idea of the revolving hook which is the main feature of the Willcox & Gibbs machine. In all he took out 12 patents covering the sewing-

machine. The village in which he resided was named by him when he returned to it in middle life. The name is from the Greek word which means "to sew."

Gibbs, Josiah Willard, American philologist: b. Salem, Mass., 30 April 1790; d. New Haven, Conn., 25 March 1861. He was graduated at Yale College in 1809, and in 1824 was appointed professor of sacred literature in the theological department of Yale College, which he held till his death. He published a translation of Gesenius' 'Hebrew Lexicon of the Old Testament' (1824); 'Manual Hebrew and English Lexicon,' abridged from Gesenius (1828); 'Philological Studies' (1857); 'Latin Analyst' (1858), etc., and contributed to the periodical works of his time numerous important papers on topics of philology and criticism.

Gibbs, Josiah Willard, American mathematician: b. New Haven, Conn., 11 Feb. 1839; d. there 28 April 1903. He was a son of the preceding and was graduated from Yale in 1858. He was professor of mathematics at Yale in 1871 and held the position at the time of his death. Thermodynamics was the field in which he achieved his greatest renown. He was original in his manner of teaching and extremely successful in the class-room. The work that brought him first into prominent notice was his treatise on the 'Equilibrium of Heterogeneous Substances,' published in 1875 by the Connecticut Academy of Arts and Science. His last contribution on this subject was his book in the Bi-Centennial series at Yale, entitled 'An Elementary Treatise on Statistical Mechanics,' wherein he set forth what are likely to be the foundations of this branch of science in the future. In 1881 he began the development of the Vector analysis and applied it to problems in crystallography and to the computation of the orbits of the planets and comets and also to problems in the theory of light. His work gave strong support to the electro-magnetic theory and powerful influence in securing a general adoption of this theory by physicists.

Gibbsite, gĭb'zīt, a mineral usually occurring in mammillary or stalactitic masses or incrustations, or in monoclinic crystals (hydragillite). Its color is usually white, often tinted with green, yellow or red. Its hardness is 2.5 to 3.5 and its specific gravity about 2.4. It is an aluminum hydrate, $Al(OH)_3$, containing 28 per cent of aluminum. It occurs in the Urals, Norway, Brazil and at Richmond, Mass. It was named after George Gibbs (q.v.).

Gibeah, gĭb'ē-ä, the name of several towns in ancient Palestine, the birthplace of Saul, and the scene of Jonathan's romantic exploit against the Philistines.

Gib'el, or **Prussian Carp,** a European carp (*Cyprinus gibelio*) of small size, without barbels and with a forked tail. It occurs in England and is good food.

Gib'eon, one of the ancient cities of the Canaanites, in Palestine, a "great city" of the Hivites, who at an early stage of Joshua's conquests entered into a stratagem to get terms of peace for themselves. Taking old clothes on their persons, and dry and moldy bread in their bags, they professed to have come from a far country, and proposed an alliance with the Israelites, which was accepted by Joshua before the stratagem was discovered. When the discovery was made, the covenant was strictly observed, but the Gibeonites were condemned to be "hewers of wood and drawers of water unto all the congregation" (Jos. ix. 21). The town of Gibeon fell afterward to the lot of Benjamin. It was made a Levitical city, and the Tabernacle was transferred there from Nob after the slaughter of the priests. The engagement between the men of Abner and David took place here. Gibeon has been identified with the modern El-Jib. A large number of the Gibeonites, who had made a covenant with Joshua, were massacred by Saul, for which crime seven of Saul's sons were delivered up by David to the Gibeonites to be hanged (2 Sam. xxi. 1–9).

Gibraltar, jĭ-brâl'tar (Sp. hē-bräl-tär'), a town and strongly fortified rocky peninsula at the southern extremity of Spain, at the western entrance of the Mediterranean, belonging to Great Britain. This remarkable fortress, which lies opposite Ceuta in Africa (distance between Europa Point and Ceuta 14½ miles), and forms the key to the Mediterranean, is connected with the mainland of Spain by a low sandy isthmus, the peninsula having the Bay of Gibraltar on the west, and the open sea of the Mediterranean on the east. The British territory has a length of 2¾ miles and a greatest breadth of ¾ of a mile, the greater part of it consisting of "the rock," at the foot of which, on the north, is a race course, cemetery, etc. The highest point of the rock is about 1,400 feet above sea-level. Its north face is almost perpendicular, while its east side also presents tremendous precipices. On the south it is almost inaccessible, making approach from seaward impossible; the west side, again, although nearly as rugged and precipitous as the others, slopes toward the sea; and here the rock is secured by extensive and powerful batteries, and other works rendering it apparently impregnable. The body of the rock consists of a kind of dense limestone arranged in beds of 30, 40, and 50 feet in thickness. There are a number of remarkable caves in various parts of the rock, but all difficult of access.

Vast sums of money and an immense amount of labor have been spent in fortifying this celebrated stronghold. Numerous caverns and galleries, extending two to three miles in length, and of sufficient width for carriages, have been cut in the solid rock, forming safe and sheltered communications from one part of the garrison to another in cases of attack. Along these galleries are port-holes opening toward the bay or toward the Spanish territory (between which and the British territory there is a strip known as "the neutral ground"); while trees, shrubs, and flowers of various kinds have been planted at different points, both for ornament and utility. On the summit of the rock there are barracks, signal-stations, etc. Of late years the fortifications have been carefully strengthened at every vulnerable point, and guns of the newest construction have been mounted in them. Gibraltar has a naval dockyard, and is a victualing and coaling station of the British navy. Great harbor works have for some time been in course of construction (at a cost of some $20,000,000), including a large area of sea enclosed by massy walls, and graving-docks large enough to accom-

modate the largest battle-ships. The materials have been mostly brought from the east side of the rock by means of a tunnel specially constructed for this purpose.

The town of Gibraltar is situated on the west side of the peninsula, fronting the bay. It consists of two portions, the North Town and the South Town, the former being much the larger and separated from the South Town by the Alameda Gardens, parade ground, etc. The principal buildings are the governor's house, the naval hospital, the civil hospital, the garrison library (45,000 vols.), the court-house, revenue offices, remains of an old Moorish castle, and the barracks. The water for the supply of the town and garrison is collected in tanks during the rainy season. Splendid reservoirs for water have recently been constructed by the government. Gibraltar is a free port, and serves as a valuable entrepôt for the distribution of British manufactures to the neighboring countries. The administration is vested in the governor, who is also commander-in-chief of the troops; and the settlement is treated as a garrison town, the power of enacting laws being vested in the governor alone. All criminal cases are determined according to the laws of England. Newcomers to Gibraltar are stringently looked after. Foreigners are permitted to remain during specified periods only, and on giving the required security. The population in 1901 amounted to 27,460, including a garrison of 5,349 men. The permanent residents are of very various origin — Spanish, Portuguese, Maltese, etc.

The name is formed from the Arabic words *gebel al Tarik* (the height or rock of Tarik), since Tarik Ibn Zeiad, the general of the caliph Valid, at the time of the irruption of the Moors into Spain (711 A. D., and following years), landed at the foot of this rock (known as the *Calpe* of antiquity and one of the *Pillars of Hercules* — Abyla in Africa being the other), where he founded a strong fortress. About the beginning of the 14th century it was taken from the Moors by Ferdinand, king of Castile, but in 1333 it was recovered by them, and was not finally acquired by the Spaniards till 1462, when it was taken in the reign of Henry IV. The Duke of Medina-Sidonia, who had assisted in gaining it for the Christians, took forcible possession of it for himself, and it remained in the keeping of his family till 1501, when the Spanish sovereign got it into his own hands. The third duke unsuccessfully tried to recover it in 1506, by which time the fortress had undergone altogether some half score of sieges. The pirates of Algiers subsequently made an attack upon it, but were forced to retire. The German engineer, Speckel of Strasburg, in the reign of the Emperor Charles V., substituted for the old Moorish fortifications works in the European style. In the war of the Spanish Succession the Spaniards were obliged to surrender this fortress, 4 Aug. 1704, to the British admiral Rooke, assisted by a body of troops under Prince George of Darmstadt. From October 1704 to April 1705 it was besieged by the Spaniards. It was secured to Britain by the Peace of Utrecht in 1713. Since this time nothing has been omitted by Britain to render this fortress, which forms a bulwark of her Mediterranean trade, absolutely impregnable. As the increasing value of the place rendered the possession of Gibraltar more desirable to Spain, the siege of it was commenced 7 March 1727, but raised upon the approach of Admiral Wager, with 11 ships of the line. Spain then offered £2,000,000 sterling for the delivery of the place, but in vain; and by a compact at Seville in 1729 Spain agreed to renounce all its claims upon it. Still the Spaniards omitted nothing to prevent all entrance into the fortress, and to cut it off from the mainland, by constantly strengthening the lines of St. Roch and Algeciras. But it was easy to supply the inhabitants and garrison by sea. In the war which broke out between Britain and Spain in 1779 the last attempt was made for the recovery of Gibraltar. It now underwent the famous four years' siege from 1779 till 1783, but was ably and successfully defended by Gen. Elliot, afterward Lord Heathfield. It was secured to Britain by the Peace of 1783. Since that time, in the various British and Spanish, and also French wars, Gibraltar has only been blockaded on the land side.

Gibraltar of America, Quebec, Canada; so called on account of its commanding situation and its well-nigh impregnable defenses, both natural and artificial. It is the most securely fortified city in America.

Gibraltar of the East, a name given to Aden, a town and seaport of Arabia. Since 1839 it has belonged to the British, and its fortifications have been greatly strengthened and improved. The citadel is built on a rocky eminence, and is of great strategic importance, having a position between Asia and Africa like that of Gibraltar between Europe and Africa.

Gibraltar, Bay of, an inlet of the Atlantic formed by the headland of Cabrita and Europa Point, four miles distant from each other, and is spacious and well adapted for shipping, being protected from all the more dangerous winds; the extreme depth within the bay is 110 fathoms. To increase the security of the harbor, two moles have been constructed, which respectively extend 1,100 and 700 feet into the bay. The Spanish town and port of Algeciras lie on its western side.

Gibraltar, Straits of (anciently called PILLARS OF HERCULES); the straits connecting the Mediterranean Sea with the Atlantic Ocean, extending from Cape Spartel to Cape Ceuta on the northwest coast of Africa, and from Cape Trafalgar to Europa Point on the southwest seaboard of Spain. They narrow toward the east, their width between Europa Point and Cape Ceuta being only 15 miles, while at the west extremity it is 24 miles. Length, about 30 miles. Through these straits a constant current runs so strongly from the Atlantic that sailing vessels bound west can pass them only by the aid of a Levanter, or strong breeze from the east. It is believed that the waters of the Mediterranean find an outlet here by means of an undercurrent.

Gibraltar Ape or **Monkey.** See BARBARY APE.

Gibson, Charles Dana, American illustrator: b. Roxburg, Mass., 14 Sept. 1867. He studied at the Art Students' League (New York), became known as an illustrator for periodicals, particularly for the comic weekly, 'Life,' and through his satirical presentations of wealthy society attained a wide reputation. He has published various collections of his drawings.

Gibson, John, English sculptor: b. near Conway, Wales, 19 July 1790; d. Rome 26 Jan. 1866. He was the son of a landscape gardener, and was apprenticed to a wood-carver at Liverpool, where he attracted attention by a figure of 'Time,' modeled in wax, which he exhibited at the age of 18. The patronage of W. Roscoe (q.v.) assisted him to go to Rome, where he was cordially received by Canova. On the death of Canova in 1822 Gibson entered the studio of Thorwaldsen. In 1836 he was made a royal academician; but to the end of his life continued to make Rome his chief place of residence. Among his best works are: 'The Wounded Amazon'; 'The Hunter and His Dog'; 'Hylas and the Nymphs'; 'Helen'; 'Proserpine'; and 'Sappho.' The subjects of most of Gibson's works are taken from classical mythology, but he was no servile imitator of the antique; on the contrary, he exhibited thorough originality in his treatment, and gave marked individuality and expression to the goddesses, nymphs, and heroines of antiquity that proceeded from his studio. He was the author of one remarkable innovation, at least in modern sculpture, that of coloring his figures, and though he believed to the last that the experiments of this nature which he made were successful, he never succeeded in securing the approbation of other artists for the practice.

Gibson, Randall Lee, American politician: b. Spring Hill, Woodford County, Ky., 10 Sept. 1832; d. Hot Springs, Ark., 15 Dec. 1892. He was graduated from Yale in 1853, studied law in Tulane (then the University of Louisiana) and Berlin, was a sugar planter in Louisiana until the Civil War, entered the Confederate army in the ranks, and finally attained the rank of major-general. Subsequent to the War he practised law, and having entered public life was elected to Congress as a Democrat in 1872, though not seated, was in the House from 1874–82, and in the Senate from 1882 until his death.

Gibson, Robert Atkinson, Protestant Episcopal bishop: b. Petersburg, Va., 9 July 1846. He entered the ministry in 1870, was rector of Moore Memorial Chapel, Richmond, Va., 1872–8; of Trinity Church, Parkersburg, W. Va., 1878–87; and Christ Church, Cincinnati, 1887–97. In November of the year last named he was consecrated coadjutor-bishop of Virginia, succeeding to the bishopric on the death of Bishop Whittle in 1902.

Gibson, Robert Williams, American architect: b. Essex, England, 17 Nov. 1854. He studied at the Royal Academy of Arts, came to the United States in 1881 and has since practised his profession in New York. He has designed many important American buildings, among which are the Episcopal Cathedral at Albany, N. Y., and many churches, the Botanical Museum, New York, and banks at Buffalo, Albany, Utica, and elsewhere.

Gibson, William Hamilton, American artist and author: b. Sandy Hook, Conn., 5 Oct. 1850; d. Washington, Conn., 16 July 1896. Many of his illustrations appeared in the 'Art Journal' and in 'Picturesque America'; and his illustrations of books were numerous and popular. He published: 'Camp Life in the Woods' (1876); 'Pastoral Days' (1881); 'Highways and Byways' (1883); 'Strolls by Starlight and Sunshine' (1891); 'Sharp Eyes' (1896).

Gid, gĭd, or **Staggers,** a disease of sheep caused by a larval tape-worm (*Coenurus*) in the brain. See SHEEP, DISEASES OF.

Giddings, Franklin Henry, American sociologist: b. Sherman, Conn., 23 March 1855. He was graduated from Union College in 1877, and engaged in journalism until 1888, when he became lecturer in political science at Bryn Mawr. In 1894 he became professor of sociology at Columbia University. He has written: 'The Principles of Sociology'; 'The Theory of Socialization'; 'The Elements of Sociology'; 'Democracy and Empire'; and 'Introduction to Sociology.' He has greatly aided in systematizing the facts and theories of his department, and is distinguished from other modern sociologists by the emphasis he lays on the "consciousness of kind" as the distinguishing motive of the social individual, and one of the chief factors in the organization of society.

Giddings, Joshua Reed, American statesman: b. Athens, Pa., 6 Oct. 1795; d. Montreal, P. Q., 27 May 1864. He was admitted to the Ohio bar in 1820; elected a member of its legislature in 1826, and of Congress in 1838, where he was prominent as an opponent of slavery. Not only did he predict the tightening of the slavery chain about the neck of the two parties, but he foresaw the armed struggle. On different occasions in different speeches, he prophesied the Civil War and as a political abolitionist sought to hasten it by using the power of political organization. In 1861 he was appointed consul-general to British North America. Among his works are: 'The Exiles of Florida' (1858); 'The Rebellion: Its Authors and Causes' (1864).

Gid'eon (Heb. Feller, Hewer), deliverer of Israel from the Midianites. These nomad Arabs of the Syrian and Arabian deserts had invaded the central district of Palestine. In one of their expeditions they had murdered Gideon's brothers at Tabor. He is called by an angel of the Lord to save Israel. He is also bidden to destroy the altar of Baal, and to erect a sacrificial altar to Jehovah in its place. He gains from the performance of this command the name of Jerubbaal. Collecting the men of his clan Abieger he surprises the Midianites under cover of night, drives them toward the Jordan and captures and slays the two princes Oreb and Zeb. Continuing his pursuit to the Jordan he overtakes and kills the kings Zeba and Salmunna. The Israelites wished to make Gideon king as a reward for his valor, but he asks merely for the golden earrings taken in the spoil, out of which he makes and sets up an ephod to Jehovah. The victory of Gideon is one of the remarkable events in Jewish history. "The day of Midian" is spoken of in the prophets, and allusions are found to it also in the Psalms, and even in the Book of Revelations.

Giessbach (gēs'bäH) **Falls,** Switzerland, a cataract of the Giessbach, falling into Lake Brienz; consisting of 7 cascades, the largest of which has a fall of 190 feet.

Giffen, SIR **Robert,** English economist: b. Strathaven, Scotland, 22 July 1837. He went to London in 1862, where he was acting editor of

the 'Economist' under Walter Bagehot 1868-76; then founded the 'Statist' and became chief of the Statistical Department in the board of trade and assistant secretary in 1882. He was John Morley's assistant on the 'Fortnightly Review' in 1873–6; and is the author of reports, papers, and essays which have given him a high rank. His works include: 'American Railways as Investments' (1873); 'Stock Exchange Securities' (1877); 'Essays in Finance' (1870); 'The Progress of the Working Classes in the Last Half Century' (1884); 'The Growth of Capital' (1890); 'The Case Against Bimetallism' (1892).

Gifford, Robert Swain, American artist: b. Naushon Island, Mass., 23 Dec. 1840; d. New York 15 Jan. 1905. He studied with Albert Van Beest in Rotterdam, Holland; traveled through California and Oregon in 1869, and in Europe and North America 1870–1. He was best known as a painter of landscapes and seashore scenes, and among noted paintings by him were: 'The Rock of Gibraltar'; 'A Lazy Day in Egypt.'

Gifford, Sandford Robinson, American artist: b. Greenfield, N. Y., 10 July 1823; d. New York 29 Aug. 1880. He was educated at Brown University; studied painting in Europe 1855–7. His works include: 'A Lake Scene on the Catskills'; 'Ruins of the Parthenon'; 'Sunrise on the Matterhorn'; 'Home in the Wilderness'; 'Lake Geneva'; 'Fishing-Boats in the Adriatic'; 'San Giorgio, Venice'; etc.

Gifford, William, English critic: b. Ashburton, Devonshire, April 1757; d. London 31 Dec. 1826. He studied at Oxford, afterward traveled on the continent with Lord Belgrave for some years, and on his return to England devoted his time to literary pursuits. In 1794 he published 'The Baviad,' a poetical satire, in which the poetasters of the Della Crusca school are the chief objects of his ridicule; and in 1795 appeared 'The Mæviad,' a severe animadversion on the degraded state of the drama. These works, though virulent and coarse, display much critical ability. In 1797 he became editor of the Anti-Jacobin newspaper — an office which involved him in a quarrel with Dr. Wolcot, against whom he published a pamphlet in verse, entitled 'An Epistle to Peter Pindar.' His translation of the 'Satires of Juvenal' was published in 1802, and is executed in a manner highly creditable to his abilities. He edited the plays of Massinger, with notes, and a life of that dramatist (1805); and afterward in a similar manner the works of Ben Jonson, Ford, and Shirley. He also translated the 'Satires of Persius.' In 1809 he entered on the editorship of the 'Quarterly Review,' of which he continued to be conductor till 1824, when he resigned. He was interred in Westminster Abbey.

Gift, Theo. See BOULGER, DOROTHY HENRIETTA.

Gigan'tism, a rare form of disease supposed to be associated with changes in the pituitary body; characterized by abnormal processes of growth, chiefly in the bones of the face and extremities. Most giants, as seen in circuses, etc., have this disease or develop it in time. Technically the disease is known as acromegaly (q.v.).

Gigantostraca, jī-găn-tŏs'tra-ka. See EURYPTERUS.

Gignoux, François Regis, frän-swä rā-zhē zhēn-yoo, French painter: b. Lyons 1816; d. Paris 6 Aug. 1882. He studied at the Beaux-Arts and with Delaroche, and in 1840–70 was in the United States, where he became a national academician. Many of his works are in the possession of private collectors of New York. He painted chiefly studies of natural scenery, such as 'The Indian Summer'; 'Niagara by Moonlight'; 'The Bernese Alps at Sunrise.'

Gigoux, Jean, zhŏn zhē-goo, French painter: b. Besançon 8 Jan. 1809; d. 10 Dec. 1894. He studied at the Beaux-Arts, and as a pupil of Géricault and Sigalon, and achieved a high reputation by his historical works, religious and secular, in which he displayed forcible coloring and a faithful attention to detail. By his drawings on the stone, he did much to further the development of lithography. He executed 600 illustrations for an edition of 'Gil Blas.' Among the best of his paintings are: 'The Eve of Austerlitz'; 'The Good Samaritan,' and 'The Death of Leonardo da Vinci,' his chief work now hung in the Besançon Museum. He published: 'Causeries sur les artistes de mon temps' (1885).

Gihon, gī'hŏn, **Albert Leary,** American sanitarian: b. Philadelphia, Pa., 28 Sept. 1833; d. New York 17 Nov. 1901. He was appointed assistant surgeon in the United States navy in 1855; took part in the attack and capture of the barrier forts, near Canton, China, in 1856; and served throughout the Civil War. He was promoted medical director in 1895, and was retired with the rank of commodore the same year. He published: 'Practical Suggestions in Naval Hygiene'; 'Need of Sanitary Reform in Ship Life'; 'Sanitary Commonplaces Applied to the Navy'; 'Prevention of Venereal Diseases by Legislation'; and was editor of 'Annual of the Medical Sciences' for six years.

Gil Blas (zhēl bläs) **of Santillane,** sän-tīl-ăn, **The Adventures of,** a famous romance by Alain René Le Sage. It is a series of pictures of life among all classes and conditions of people in Spain two centuries ago. The narrative runs on, with excursions and interpolated histories, and the thread of the story is as inconsequential as that of a tale of the 'Arabian Nights.' The charm of the work is its absolute truth to human nature, and its boundless humor and satire. These qualities have made it a classic. Le Sage was a Frenchman, who never saw Spain; but through his familiarity with its literature he produced a work so essentially Spanish in its tone and spirit as to provoke long controversy as to its originality. Its writing occupied 20 years; the first two volumes appearing in 1715, and the last in 1735. It has been translated into many languages, the earliest in English; the one which has remained the standard being by Tobias Smollett.

Gila, hē'lä, a river of the United States, an affluent of the Colorado, origin in New Mexico; length 450 miles. Its upper course is through mountains, with many deep and precipitous cañons; farther south it flows through an open and comparatively level country, the valley being productive when irrigated. About 200 miles from the Colorado is the reservation of the Maricopa and Pima Indians. Ancient ruins are numerous on the banks of the Gila.

Gila Monster, the poisonous lizard (*Heloderma suspectum*) of the sandy deserts of the southwestern United States, so called because first brought to notice in the valley of the Gila River, Arizona, and on account of the great size (two feet in length) which it sometimes attains. Another "species" (probably a variety — *H. horridum*) exists in the arid parts of Mexico, where it is called "caltotepon" or crust-lizard. These constitute a family *Helodermatidæ*, characterized by the presence of pleurodont, fang-like teeth, each with a groove on its front and rear surface, and each having near its base a labial gland which secretes venom of the same nature as that of serpents. The food of these lizards consists of worms, centipedes, the eggs of birds and lizards, frogs and other small animals which its bite paralyzes or kills. It is slow to anger, but instances are on record of its biting men, producing illness and in some cases death.

Gilbert, Anne Hartley, American actress: b. Rochdale, England, 21 Oct. 1821; d. Chicago, Ill., 2 Dec. 1904. She was a graceful dancer in early life, and later became very successful in high comedy. She was married to George Henry Gilbert, a dancer, in 1846. She visited the United States in 1846, and in 1849 made her home here. For many years before her retirement she was a member of the Daly Company, her especial roles being those of old women, in which she achieved very marked success. On 21 Oct. 1899, her birthday was observed by her admirers by a special performance, a reception, and the presentation of a silver service at the Lyceum Theatre, New York. Her 'Stage Reminiscences' was published in 1901.

Gilbert, Charles Henry, American educator: b. Rockford, Ill., 5 Dec. 1859. He was graduated at Butler University, Ind., in 1879, and became professor of zoology in the Leland Stanford University in 1891. He is the author of 'Synopsis of the Fishes of North America,' with D. S. Jordan (q.v.).

Gilbert, Grove Karl, American geologist: b. Rochester, N. Y., 6 May 1843. He was graduated from the University of Rochester in 1862 and has been geologist of the United States Geological Survey from 1879. He has published: 'Geology of the Henry Mountains' (1879–82); 'Lake Bonneville' (1890); and numerous reports issued under the direction of the United States government.

Gilbert, Sir **Humphrey,** English navigator: b. Devonshire 1539; d. September 1583. He studied at Eton and Oxford, and adopting the military profession, he served with reputation in France and Ireland. He was knighted in 1570, and sat in the House of Commons as member for Plymouth in the following year. Possessing a strong propensity for speculation and enterprise, he turned his attention to maritime exploration, and published 'A Discourse of a Discovery for a New Passage to Cataia' (1576; reprinted in Hakluyt's collection of voyages, Vol. III.). In 1578 Sir Humphrey Gilbert obtained from the Queen a patent empowering him to discover and colonize in North America any land then unsettled. His first voyage ended in failure, but in 1583 he sailed again with a small fleet, and, having landed on Newfoundland, he took possession of the harbor of St. John's. On his return voyage to England in a small sloop he was lost in a storm. See 'Lives by Tytlor (1833); St. John (1868); Edwards (1868); Payne, 'Voyages of the Elizabethan Seamen' (1880).

Gilbert, Sir **John,** English painter: b. Blackheath, near London, 21 July 1817; d. Villers-sur-Mer, France, 5 Oct. 1897. In 1836 he began to exhibit both in oil and water colors; and in 1852 he was elected an associate, in 1853 a member, in 1871 the president of the Society of Painters in Water Colors, receiving soon after the honor of knighthood. He also became an A.R.A. in 1872, an R.A. in 1876, and a chevalier of the Legion of Honor. His oil paintings include: 'Don Quixote and Sancho Panza'; 'Education of Gil Blas'; 'Murder of Becket'; 'Joan of Arc Entering Orleans'; 'Crusaders'; 'Wolsey at Leicester,' and 'Morning of Agincourt.' He was a well-known and popular illustrator of books.

Gilbert, Linda, American philanthropist: b. Rochester, N. Y., 1847; d. 1895. She became known for her work in the interest of prison reform, and by her success in placing libraries in prisons. She was also foremost in obtaining the incorporation under the laws of New York of the Gilbert Library and Prisoners' Aid Society.

Gilbert, Rufus Henry, American inventor: b. Guilford, N. Y., 26 Jan. 1832; d. New York 10 July 1885. He was graduated at the New York College of Physicians and Surgeons; served as surgeon in the Union army in the Civil War; and was appointed superintendent and medical director of the United States army hospitals. Owing to the failure of his health after the war he abandoned his profession and engaged in the railroad business, making a special study of the needs of rapid transit in New York. The result was the erection of the first elevated railroad in that city.

Gilbert, William, English physician and physicist: b. in 1540 at Colchester, a town in Essex 50 miles from London; d. in 1603, and was buried in Trinity church, Colchester. At the age of 18 he entered Saint John's College, Cambridge, from which he graduated in 1560. In 1564, after taking his M.A. degree, he was appointed mathematical examiner of his college. Later, he devoted himself to the study of medicine, obtaining the Doctorate in 1569 and at the same time a senior fellowship in the University. Leaving Cambridge the same year, he went abroad for four years. In 1601, he was elected President of the Royal College of Physicians, an honor which was followed by his appointment as chief physician to Queen Elizabeth.

Gilbert's fame rests on the discoveries which he made in electricity and magnetism and which he tersely recorded in his work on the magnet, 'De Magnete magneticisque Corporibus,' published in London in 1600. He devoted all the time he could spare from his professional duties during a period of 18 years to the researches described in this remarkable treatise, which researches he informs the "candid reader" cost him over £5,000. By way of distinction, he marks his discoveries with marginal asterisks, large ones denoting important discoveries and small ones, those of minor note. Of the former, there are 21; of the latter 178. Besides a re-

markable title-page, the work contains 84 illustrations.

In magnetism, Gilbert recognizes the magnetic field, the effects of heat, magnetic induction and magnetic screening; but his cardinal discovery is that the earth itself is a great magnet with its magnetic poles, equator and axis. He was led to this generalization by prolonged experiments with globular magnets, or terrellas, on which he poised small magnetic needles, finding that, however placed, they always pointed to the poles. He confirmed his theory by reference to the prevalence of magnetic materials in the crust of the earth, the behavior of the compass-needle and the dip circle, and also by the magnetic condition of vertical masses of iron such as the crosses of church-steeples.

Gilbert was an ardent advocate of the Copernican theory and there is reason to believe that his magnetic work was undertaken in its defence, convinced as he was that the revolution of the earth round the sun and its suspension in space would follow at once from the magnetic attraction of the other planets provided the earth itself could be proved to be a colossal magnet. Gilbert was belittled in *De Augmentis Scientiarum* by Chancellor Bacon, who was a staunch anti-Copernican, but was praised and admired by Galileo and Kepler. Two translations of 'De Magnete' have been made, the first by P. Fleury Mottelay of New York (1893), and the second by the Gilbert Society of London (1900). Gilbert's work stands out as the second landmark on magnetic philosophy, the first being a treatise on the lodestone by Peregrinus (q.v.) A.D. 1269.

BROTHER POTAMIAN,
Professor of Physics in Manhattan College.

Gilbert, William Schwenck, English dramatist: b. London 18 Nov. 1836. He was the son of William Gilbert (1804–89), who published 30 novels, tales, etc. He was a clerk in the Privy Council Office 1857–62, and in 1864 was called to the bar. He contributed to the magazines, and was on the staff of 'Fun,' in whose columns his 'Bab Ballads' first appeared. His burlesque 'Dulcamara' (1866) was followed by other burlesques, dramas, comedies, fairy comedies and operas, chief of which was the celebrated series of Savoy operas written in collaboration with Sir Arthur Sullivan (q.v.) as composer. In nearly all his better-known works Gilbert displays fantastic humor that is often subtle, nearly always healthy in tone, and none the worse for a slight flavor of cynicism. His operas and 'The Bab Ballads' have been exceedingly popular in America. See P. Fitzgerald, 'The Savoy Opera and the Savoyards' (1894).

Gilbert Islands, or **Kingsmill Group,** a group of 15 islands in the South Pacific Ocean, between lat. 1° 0′ S. and 2° 30′ N.; and lon. 172° 0′ and 174° 30′ E. They are the most easterly of the groups collectively constituting Micronesia and are of coral formation, all low, the highest land in the group not exceeding 20 feet. The natives resemble the Malays. The whole group is under the protection of Great Britain, but the islands are self-governed, a sort of republicanism prevailing. Pop. (est.) 40,000.

Gil′bertines, The, a religious order founded about 1141 by Saint Gilbert (1083–1189), a parish priest of Sempringham, Lincolnshire, England. It was the only purely English order ever established prior to the Reformation. At the dissolution of the order, in the reign of Henry VIII., it numbered 22 convents. See Graham, 'Saint Gilbert of Sempringham and the Gilbertines' (1901).

Gilboa, gĭl-bō′a, a chain of hills in Palestine, between 500 and 600 feet high, overhanging the site of the ancient city of Jezreel, and rising between the fertile plain of Esdraelon and the valley of the Jordan. It is memorable as the scene of the defeat and death of King Saul and his three sons at the hands of the Philistines.

Gilchrist, gĭl′krĭst, **William Wallace,** American musician: b. Jersey City, N. J., 1846. He was a pupil of Clarke at the University of Pennsylvania, was an organist in Cincinnati 1872–83, and from that time was in Philadelphia, where he became a member of the faculty of the Musical Academy and a leader of choral societies in eastern States. His setting of Psalm XLVI. for solo voices, chorus, organ, and orchestra obtained the prize for composition at the Cincinnati festival of 1882, and his choral works are well known.

Gilder, gĭl′dėr, **Jeannette Leonard,** American editor: b. Flushing, N. Y., 3 Oct. 1849. Having entered journalism in 1869, she became editorially connected with 'Scribner's Monthly' (the present 'Century Magazine'), was a member of the New York *Herald* staff as literary editor and later musical and dramatic editor (1875–80), and in 1881 with her brother, J. B. Gilder (q.v.), founded and became editor of the 'Critic,' a monthly review of literature, drama, and art. Her publications are: 'Taken by Siege' (1886–96); and 'The Autobiography of a Tomboy' (1900). She also dramatized Sienkiewicz's 'Quo Vadis.'

Gilder, Joseph B., American journalist: b. Flushing, N. Y., 29 June 1858. After varied experience in journalism he, with his sister, J. L. Gilder (q.v.), established the 'Critic,' of which he became an editor. In 1895 he was appointed literary adviser to the Century Company and subsequently London representative of Dodd, Mead & Company. He edited 'Orations and After-Dinner Speeches of C. M. Depew' (1890), and other publications.

Gilder, Richard Watson, American editor and poet: b. Bordentown, N. J., 8 Feb. 1844. After secondary schooling he was a private of artillery during the emergency campaign in Pennsylvania (1863), and later managing editor of the Newark (N. J.) *Advertiser.* He subsequently established, with Newton Crane, the Newark *Register,* was editor of 'Hours at Home,' a monthly of New York, and when this was merged in 'Scribner's Monthly' became managing editor of the latter (1870). In 1881 he succeeded J. G. Holland (q.v.) as editor-in-chief of the 'Monthly,' in which capacity he remained after it became the present 'Century Magazine.' He was prominently identified with public affairs as chairman of the New York Tenement-house Commission (1894), member of the council of the National Civil Service Reform League, and other posts, and was a founder of the Authors' Club, the International Copyright League, and the Society of American Artists. The best of his verse, most of which originally appeared in magazines, was collected in 'Five Books of Song' (1894). Later volumes

are: 'In Palestine, and Other Poems' (1898), and 'Poems and Inscriptions' (1901).

Gilder, William Henry, American journalist and arctic explorer: b. Philadelphia 16 Aug. 1838; d. 1900. He served in the Civil War, and was brevetted a major at its close. He accompanied Lieut. Schwatka in 1878 on a polar expedition, and in 1881 was a member of the Rodgers expedition as a correspondent of the New York *Herald*. His chief works are: 'Schwatka's Search' (1881); 'Ice Pack and Tundra' (1883). He was a brother of R. W. Gilder (q.v.).

Gil'dersleeve, Basil Lanneau, American classical scholar: b. Charleston, S. C., 23 Oct. 1831. He was graduated at Princeton in 1849, and studied in Germany for several years. He was professor of Greek and Latin at the University of Virginia from 1856 to 1876, when he was appointed professor of Greek at Johns Hopkins University. He is the founder and editor of the 'American Journal of Philology.' Among his works are: 'Satires of Persius Flaccus' (1875); 'Justin Martyr' (1875); 'Odes of Pindar'; 'Latin Grammar' (1867); 'Essays and Studies' (1890); 'Greek Syntax' (1900).

Gilding, the art of applying and permanently attaching gold leaf or gold dust to surfaces of wood, stone, metals, etc. The Egyptian monuments present numerous traces of the existence of the art in ancient Egypt. The process seems to have been the same with that now used. The Persians also were acquainted with this art, as appears from the ruins of Persepolis. The Greeks and Romans employed gilding for many purposes. The Greeks used to gild the hoofs and horns of victims. The practice of gilding statues prevailed in the infancy of the art of sculpture, and was never entirely dropped by the ancients. The Romans used to gild sweetmeats; and many articles of furniture and utensils which have come down to us are gilt. There are also specimens of gilt glass and metals. The gilding which still remains on some ancient bronze monuments is remarkable for its brilliancy. The ancients carried the practice of gilding to a greater extent than the moderns; they gilded almost all their statues of bronze, wood, or plaster, and frequently those of marble, the ceilings of rooms, and even marble columns. The most remarkable examples of gilding employed with taste and effect in architecture, are the ceiling of St. Peter's, and that of Santa Maria Maggiore.

The art of gilding at the present day is performed on metals, or on wood, plaster, leather, parchment, paper, glass, etc. Chemical processes are those which are usually employed for metals. Gilding on copper is performed by the process called wash or water gilding, with an amalgam of gold and mercury. The surface of the copper, being freed from oxide, is covered with the amalgam, and afterward exposed to heat till the mercury is driven off, leaving a thin coat of gold. Copper, however, is rather too soft and dark-colored a metal to be treated in this way with advantage. Brass is a very suitable metal for this mode of gilding, but the best of all is a mixture of copper with one seventh of brass. The following method of gilding articles of copper, brass, etc., was patented by Elkington in 1836: Five ounces troy of fine gold are dissolved by heat in a mixture of 21 ounces of pure nitric acid of specific gravity 1.45, 17 ounces of pure hydrochloric acid of specific gravity 1.15, and 14 ounces of distilled water. The liquid is then poured off into a stone vessel, the sediment being left at the bottom of the vessel in which it was first contained. Four gallons of distilled water and 20 pounds of the best bicarbonate of potash are now added and the whole is boiled moderately for two hours. At the end of this time the mixture is ready for use. The articles are gilded by being attached to wires and plunged into the mixture, where they are allowed to remain as long as the workman thinks necessary, from a few seconds to a minute, when the mixture is newly prepared, but longer if it has been used for some time. Gilding is also performed by dipping a linen rag in a saturated solution of gold, and burning it to tinder. The black powder thus obtained is rubbed on the metal to be gilded with a cork dipped in salt water till the gilding appears. Iron or steel is gilded by applying gold leaf to the metal, after the surface has been well cleaned and heated till it has acquired the blue color, which at a certain temperature it assumes. Several leaves of gold are thus applied in succession, and the last is burnished down cold. The same process may be applied to copper. The operation of gilding may also be performed on iron and steel by diluting the solution of gold in nitro-hydrochloric acid with alcohol and applying it to the clean surface. A saturated solution of gold in nitro-hydrochloric acid, being mixed with three times its weight of sulphuric ether, dissolves the chloride of gold and the solution is separated from the acid beneath. To gild the steel it is merely necessary to dip it, the surface being previously well polished and cleaned, in the ethereal solution for an instant, and on withdrawing it to wash it instantly by agitation in water.

Gilding on wood, plaster, leather, parchment, or paper, is performed by different processes of mechanical gilding. The first of these is oil gilding, in which gold leaf is cemented to the work by means of oil size. In the case of paper or vellum the parts to be gilded receive a coat of gum water or fine size, and the gold leaf is applied before the parts are dry. They are afterward burnished with agate. Lettering and other gilding on bound books are applied without size. The gold leaf is laid on the leather and imprinted with hot brass types. Brass rollers with thin edges are employed in the same way for lines, and similar tools for other ornaments. When the edges of the leaves of books are to be gilded they are first cut smooth in the press, after which a solution of isinglass in spirits is laid on, and the gold leaf is applied when the edges are in a proper state of dryness. Japanner's gilding is another kind of mechanical gilding which is performed in the same way as oil gilding, except that instead of gold leaf a gold dust or powder is employed.

Porcelain and other kinds of earthen-ware as well as glass may be gilded by fixing a layer of gold in a powdered state by the action of fire. The gold dust or powder required in this operation may be obtained by precipitating it from a solution in aqua regia, either by means of sulphate of iron or protonitrate of mercury. In order that the gold powder may be applied to the surface of the article to be gilded it must be

well mixed with some viscous vehicle such as spirits of turpentine mixed with some fatty matter, or strongly gummed water. It is then laid on with a fine camel's hair brush. When the article to be gilded is made of soft porcelain, delft-ware, or any kind of earthen-ware with a plumbiferous glazing, nothing else is required than to apply the gold in this manner, and then subject the piece of earthen-ware to a heat sufficient to soften the glazing, and thus fix the gilding. But in the case of hard porcelain, some kinds of stoneware and other varieties of pottery, in which the glazing does not soften at a suitable temperature, the gold powder, before being mixed with the viscous vehicle by which it is applied, must have a flux added to it, which serves as a means of attachment between the metal and the earthen-ware. The best flux is oxide of bismuth precipitated by water from a solution of nitric acid, with the addition of one twelfth part of melted borax. One tenth or one fifteenth part of this flux is added for every part of gold contained in the mixture, which is applied to the surface of the earthen-ware. Heat is applied in the same way as in the previous case to melt the flux, and thus fix the layer of gold to the article. The gilding must finally be burnished in order to bring up the gold color. Another method of gilding these substances is to mix neutral chloride of platinum with rectified spirits of turpentine in such a manner that the chloride is held in suspension in a finely divided state in the turpentine, to apply this liquid to the article to be gilded by means of a brush, and then to subject the article to heat so as to volatilize the spirits of turpentine and leave a uniform layer of platinum affixed to the glass or earthen-ware. The article, after being cooled, cleaned with aqua fortis, and washed with water, is next dipped in a gilding liquid prepared like that already described as patented by Elkington. The gilding is completed by rubbing the gilt parts with chamois leather. This method of gilding has the advantage of enabling the gilder to dispense with the burnishing, which is a very hazardous operation for fragile articles, and in the case of those which are of a very intricate form or very deeply cut out often impracticable. See METALLURGY.

Gilead, gĭl'e-ad (rough, rugged, hard), a country on the east side of the Jordan, at one time a portion of the kingdom of Israel. Its exact area is doubtful; but the southern boundary, the River Arnon, and the western boundary, the Jordan River, are well defined. The Yarmuk is given by some as a northern boundary; and some historians mention the country of Gilead as extending to the shores of the Sea of Galilee and the Plains of Bashan. The eastern boundary was "the desert." It is a mountainous country traversed by many small streams which flow into the Jordan. All the mountains are mentioned frequently as "mountains of Gilead," and one peak is called in ancient history, "Mount of Gilead." This peak is thought to be the one now known as Jebel or Djabal (mount) Osha. The soil is fertile and the vegetation generally luxuriant. The low round mountains or hills are no hindrance to cultivation as practised by the native inhabitants. A considerable portion is devoted to pasturage and large herds of cattle and flocks of sheep graze on the hillsides and table-lands as in the times mentioned in the Old Testament. The balm of Gilead, a small evergreen tree of the *Terebinthine* family, has long been noted because of the efficacy of its balm (balm of Mecca) in healing wounds. The terebinth tree and the oak still flourish in Gilead, especially in the valley of the Jabbok. Gilead is mentioned frequently in the Bible. Much of its history before the birth of Christ is given in the Old Testament. In Deuteronomy and Numbers may be found an account of the conquest of the country and the transfer of a part to Reuben and Gad. In Judges and Kings is a record of the wars waged upon Gilead by the Syrians, the Midianites, and the Ammonites, and finally the victory of the Assyrians. The flight of Absalom is given in 2 Sam. xiii. In 1 Sam. xxi. is an account of the battle in which the sons of Saul were slain, and of Saul's own death. It is there told that "the valiant men of Jabesh-Gilead arose and went all night, and took the body of Saul and the bodies of his sons from the wall of Beth-Shan," and burned them according to the custom of the times. And afterward these "valiant men" fasted several days. The chief cities of Gilead were Jazer, Mizpeh, Mahanaim, Penuel, and Succoth.

Giles, jīlz, **Saint (Saint Aegidius),** a native of Greece, who, according to legend, lived in the 7th century. He gave all his property to the poor, and went to France, where he lived in solitude for many years. Finally he permitted companions in his retreat, and founded a house of the Benedictine order. A town grew up around it, and was called Saint Giles. The saint is the patron of many churches in France, Germany, Scotland, and Poland.

Giles, Saint (Saint Giles in the Fields), a parish in London, a mile to the northwest of St. Paul's. The church is in classical style, and contains the remains of Chapman, Shirley, Marvell, Lord Herbert of Cherbury, and Sir Roger L'Estrange. One district of it, by its poverty and wretchedness, long formed a very striking contrast to the west end of the metropolis, so that Saint Giles and Saint James were spoken of as typical of wretchedness and luxury respectively. There is another London church of Saint Giles, called Saint Giles Cripplegate, which contains the tomb of Milton.

Giles, William Branch, American politician: b. Amelia County, Va., 12 Aug. 1762; d. Albemarle County, Va., 4 Dec. 1830. He was educated at Hampden-Sidney College and at Princeton, studied law and practised at Petersburg, was a member of the Federal House of Representatives in 1790–8 and 1801–2, and of the Senate in 1804–15. In 1827–30 he was governor of Virginia. Originally a Federalist, he later became a Republican, and was the leader of his party in the Senate 1804–11. He took a prominent part in the Virginia Constitutional convention of 1829–30. He was an effective speaker, assertive in methods and frequently broke with his party, in which he finally lost influence. His 'Political Letters to the People of Virginia' appeared in 1813.

Gilgal, gĭl'găl, the name of several ancient towns near the Jordan, where the Israelites passed the river into Caanan, where they were circumcised and held the first Passover after leaving the desert (Joshua iv. 10). Here rested the tabernacle, till removed to Shiloh; here

Samuel held court as judge of Israel, and here Saul was crowned. It is frequently mentioned in the Bible; a school of the prophets was established here (2 Kings iv. 38), yet it afterward became a seat of heathen worship (Amos iv. 4). Josephus places one of the towns within two miles of Jericho, but no traces of it are at this day extant.

Gill, gĭl, Sir **David,** Scottish astronomer: b. Aberdeen 12 June 1843. He was chief of staff of Lord Lindsay's observatory, founded in 1870; in charge of Lindsay's expedition to Mauritius in 1874 to observe the transit of Venus and the opposition of Juno, by means of the heliometer, for the determination of the solar parallax. He determined the longitudes of Malta, Alexandria, Suez, Aden, Bombay, Seychelles, Reunion, Mauritius, and Rodriguez by cable and chronometers, and measured the first base-line for the Egyptian triangulation at the request of the khedive. In 1877 he was in charge of the expedition to Ascension to observe the opposition of Mars for parallax; and in 1879 appointed director of the Cape Observatory. He has published many valuable professional papers and reports.

Gill, Henry Z., American physician: b. Richboro, Pa., 6 Oct. 1831. He was a surgeon in the Union army during the Civil War; and was professor of chemical and operative surgery in Wooster University 1883–6; removing to Kansas in the year last named. His publications include: ‹Report on the Prisons of the United States›; ‹Gill's Sanné on Diphtheria, Croup, and Tracheotomy›; etc.

Gill, Theodore Nicholas, American educator: b. New York 21 March 1837. He became professor of zoology in Columbian University in 1884. His publications include: ‹Arrangement of the Families of Mollusks›; ‹Arrangement of the Families of Mammals›; ‹Catalogue of the Fishes of the East Coast of North America›; and ‹Scientific and Popular Views of Nature Contrasted› (1882); ‹Principles of Geography› (1884); etc.

Gill Net, a net suspended vertically, by means of floats, and leaden weights, in standing or running water, fresh or salt. It has meshes which allow the head of the fish to pass, but are too small for the body beyond the gills to get through, and when the captive tries to draw back, catch in the gills, from which no effort can disentangle them.

Gil'lem, Alvan Cullem, American soldier: b. Jackson County, Tenn., 1830; d. near Nashville, Tenn., 2 Dec. 1875. He was graduated from the United States Military Academy in 1851, served in the Seminole war (1851–2), in the Civil War became brevet colonel, United States Army, and brigadier-general of volunteers, and upon the reorganization of the State government of Tennessee was vice-president of the convention for revision of the Constitution and a member of the first legislature of the new régime. In 1867–8 he commanded the district of Mississippi. He attained the rank of colonel and brevet major-general in the regular service.

Gillenia, jĭ-lē'nĭ-a, or **Proteranthus,** a North American perennial genus of *Rosaceæ,* closely allied to *Spiræa,* embracing only two known species; also called Indian physic, bowman's root, and American ipecac. See Bowman's Root.

Gillespie, gĭ-lĕs'pĭ, **Eliza Maria,** American philanthropist: b. near West Brownsville, Washington County, Pa., 21 Feb. 1824; d. Notre Dame, Ind., 4 March 1887. In 1853 she became a member of the congregation of the Holy Cross, and after a novitiate in France was appointed in 1855 superior of the St. Mary's Academy, Bertrand, Mich. She later transferred the academy to its present location, St. Mary's, Ind., and established nearly 30 similar institutions in the United States. During the Civil War she directed from Cairo, Ill., an important hospital work for Federal soldiers. Upon the separation of the congregation of the Holy Cross in the United States from the order in Europe she was for two terms superior.

Gillespie, George de Normandie, American Protestant Episcopal bishop: b. Goshen, N. Y., 15 June 1819. He was graduated from the General Theological Seminary in New York in 1840, entered the ministry and held rectorates at Leroy, N. Y.; Cincinnati, Ohio; Palmyra, N. Y., and Ann Arbor, Mich. In 1875 he was consecrated bishop of Western Michigan. He published ‹The Communion of Saints› and other religious works.

Gillette, William, American actor and playwright: b. Hartford, Conn., 24 July 1853. He studied at the University of Boston, and at New York University; and in 1877 commenced his work on the stage, playing with different stock companies in New Orleans, Boston, New York, and other cities. He has since then acted important parts in many of his own plays. Among his best-known productions are: ‹The Professor› (1881); ‹Esmeralda› (1881), with Mrs. F. H. Burnett; ‹The Private Secretary›; ‹Held by the Enemy› (1886); ‹A Legal Wreck› (1888); ‹Too Much Johnson› (1895); Secret Service› (1896); and ‹Sherlock Holmes.›

Gillis, gĭl'ĭs, **James Melvin,** American astronomer: b. Georgetown, D. C., 6 Sept. 1811; d. Washington, D. C., 9 Feb. 1865. He entered the navy in 1827, soon obtained leave of absence and was graduated at the University of Virginia, and then spent six months in study in Paris. He was in charge of the observation of occultations and transit observations made in connection with the Wilkes exploring expedition, Gillis making the observations at the Washington end at a little observatory on Capitol Hill. He had charge of the United States astronomical expedition to the southern hemisphere, and in 1861 was appointed superintendent of the national observatory at Washington, D. C. He published: ‹Astronomical Observations› (1846); ‹Report of the United States Astronomical Expedition of 1849–52› (1855).

Gillis Land, an arctic region north of Spitzbergen, first sighted in 1707 by Gillis, a Dutchman, in lat. 81° 30′ N. and lon. 36° E., but not visited by him. Some geographers identify it with King Charles or Wiche Land, one of the Spitzbergen group.

Gill'man, gĭl'man, **Henry,** American botanist: b. Kinsale, Ireland, 16 Nov. 1833. He settled in Detroit, Mich., in 1850; and was United States consul at Jerusalem in 1886–91. During his consulate he so strongly opposed the Turkish

DANIEL COIT GILMAN,

PRESIDENT CARNEGIE INSTITUTION.

government in its expulsion of Jews from Palestine that several European countries supported him, and the exclusion laws were modified. He is the author of 'The Wild Flowers and Gardens of Jerusalem and Palestine' (1894); 'Hassan' (1896); etc.

Gillmore, gĭl'môr, **Quincy Adams**, American military officer: b. Black River, Lorain County, Ohio, 28 Feb. 1825; d. Brooklyn, N. Y., 7 April 1888. He was graduated at West Point in 1849; promoted captain in 1861, and brigadier-general of volunteers in 1862. He displayed skill as an engineer by the capture of Fort Pulaski in April 1862, and was appointed commander of the Department of the South in June 1863. He made a successful attack on Morris Island in July 1863, began to bombard Fort Sumter and Charleston in August, and took Fort Wagner in September; Fort Sumter was reduced to a ruinous condition, but its garrison continued to hold it till 17 Feb. 1865. Gen. Gillmore commanded the Tenth corps near Richmond in 1864, and was brevetted major-general, United States Army, in 1865.

Gillott, jĭl'ŏt, **Joseph**, English manufacturer: b. Sheffield 11 Oct. 1799; d. Birmingham 6 Jan. 1872. He shares with Sir Josiah Mason the credit of having brought the manufacture of steel pens to its present state of high perfection.

Gills, gĭlz, the breathing organs of fishes, larval amphibians, crustaceans, and certain other aquatic animals. See *Respiratory System*, in article ANATOMY; also FISH.

Gillyflower, jĭl'ĭ-flow-ėr, a popular English name for some of the cruciferous plants most prized for the beauty and fragrance of their flowers, as the wallflowers and stocks; also for *Hesperis matronalis*, dame's rocket or dame's violet (q.v.). The name gillyflower has been regarded as a corruption of July-flower; but in Chaucer it appears in the form *gilofre;* and the French *giroflée* indicates the true derivation from *girofle*, a clove, the smell of the clove-gillyflower, or clove-pink, having suggested the name of that flower.

Gilman, gĭl'man, **Arthur**, American educator and author: b. Alton, Ill., 22 June 1837. He was engaged in banking in New York 1857–62, when he removed to Lenox, Mass., and devoted himself to literary and educational work until he went to Cambridge in 1870. He was the originator (1876) of the Harvard Annex, of which he became executive officer, and, upon its organization as Radcliffe College, regent. In 1886 he founded and became director of the Cambridge school for girls, known as the Gilman School. He edited Chaucer's works (1879) and other collections, collaborated in several volumes of the 'Stories of the Nations' series, and wrote a number of educational works, chiefly historical in character, such as 'The Story of Rome' (1886); 'The Colonization of America' (1887).

Gilman, Caroline Howard, American author: b. Boston 8 Oct. 1704; d. Washington, D. C., 15 Sept. 1888. In 1819 she was married to the Rev. Samuel Gilman (q.v.) and removed with him to Charleston, S. C., where she began to edit in 1832 the 'Rosebud,' a juvenile weekly newspaper, which subsequently took the name of the 'Southern Rose,' and contained articles of much literary merit. From this periodical she reprinted at different times the 'Recollections of a New England Housekeeper' ([illegible]); 'Recollections of a Southern Matron' (1836); 'Ruth Raymond, or Love's Progress'; 'Poetry of Traveling in the United States'; 'Verses of a Lifetime'; 'Mrs. Gilman's Gift Book'; and other volumes. The first two of these works attracted particular attention by their practical lessons as well as their genial simplicity and humor, and passed through many editions. She was especially successful, also, in her books for children.

Gilman, Charlotte Perkins Stetson, American writer: b. Hartford, Conn., 1860. She is a daughter of Frederic Beecher (q.v.) and was married to G. H. Gilman in 1900. She is a prominent advocate of equality for women and has published 'Woman and Economics' (1898); 'In This Our World,' a book of verse (1898); 'The Yellow Wall Paper' (1899); 'Concerning Children' (1900).

Gilman, Daniel Coit, American educator: b. Norwich, Conn., 6 July 1831. He was graduated at Yale College in 1852; was professor of physical and political geography in Yale in 1856-72; and president of the University of California 1872–5. When Johns Hopkins University was founded in Baltimore, Md., in 1875, he was elected its first president and served in that capacity till 1901, when he resigned. In 1896–7 he was a member of the commission to settle the boundary line between Venezuela and British Guiana, and in the latter year also served on the commission to draft a new charter for Baltimore. He was president of the American Oriental Society 1893–1901, and has been vice-president of the Archæological Institute of America, executive officer of the Maryland Geological Survey, and president of the National Civil Service Reform League in 1901. His publications include: 'Life of James Monroe' (1883); 'University Problems' (1898); Introduction to DeTocqueville's 'Democracy in America'; 'Life of James D. Dana'; etc. On the organization of Carnegie Institution, Washington, D. C., 29 Jan. 1902, he was elected president, and in 1893 president of the American Bible Society.

Gilman, John Taylor, American statesman: b. Exeter, N. H., 19 Dec. 1759; d. there 31 Aug. 1828. In 1775, on the morning after the news of the battle at Lexington and Concord reached Exeter, he marched with 100 other volunteers to Cambridge, Mass., where he served in the provincial army. In 1782 and 1783 he was a member of the Continental Congress, and in 1797 he was chosen governor of New Hampshire, and was annually re-elected for 10 successive years. In 1813–14–15 he was again elected governor, after which he declined to be a candidate. He was a zealous Federalist, and his popularity in New Hampshire was so great that he was frequently chosen governor when his party was in the minority.

Gilman, Nicholas, American statesman: b. Exeter, N. H., 3 Aug. 1755; d. Philadelphia 2 May 1814. He was a brother of J. T. Gilman (q.v.) and like him served in the Continental army during the War of the Revolution. He represented New Hampshire in Congress in 1786, and again 1789–97, and was a United States Senator 1805–14. He was one of the

framers of the Constitution of the United States.

Gilmer, Jeremy Francis, American soldier: b. Guilford County, N. C., 23 Feb. 1818; d. 1 Dec. 1883. He was graduated at West Point and entered the engineer corps of the United States in 1839. At the opening of the Civil War he resigned his captain's commission and entered the Confederate service, becoming major-general in 1863.

Gilmor, gĭl'môr, **Harry,** American soldier: b. Baltimore County, Md., 24 Jan. 1838; d. Baltimore 4 March 1883. He entered the Confederate army at the beginning of the Civil War, became known for his exploits as scout, in 1863 raised a battalion of horse of which he was made major, and later in that year, in command of the 1st Maryland Confederate regiment, captured Frederick, Md., and Chambersburg, Carlisle, and Gettysburg, Pa. In 1864 he led Early's advance into Maryland. He was elected Baltimore's police commissioner in 1874, and wrote 'Four Years in the Saddle' (1866).

Gilmore, gĭl'mōr, **James Roberts** («Edmund Kirke»), American miscellaneous prose writer: b. Boston, Mass., 10 Sept. 1823. He was at first in mercantile life, subsequently entering journalism and literature, and his earlier works were written under the pseudonym, «Edmund Kirke.» He wrote: 'Among the Pines' (1862); 'My Southern Friends' (1862); 'Down in Tennessee' (1863); 'Life of Garfield'; 'Among the Guerrillas'; 'Adrift in Dixie' (1863); 'On the Border'; 'Patriot Boys'; 'The Rear-Guard of the Revolution'; 'John Sevier as a Commonwealth Builder'; 'The Advance-Guard of Western Civilization' (1888); etc.

Gilmore, Joseph Albree, American politician: b. Weston, Vt., 10 June 1811; d. Concord, N. H., 17 April 1867. He became superintendent of various New Hampshire railway lines, was elected to the State Senate in 1858, and re-elected in 1859. In 1863 he was elected governor by the legislature, and in 1864 re-elected by popular vote. His energy increased the troops furnished by New Hampshire to the Federal armies from 15,500 to 33,258.

Gilmore, Patrick Sarsfield, American musical conductor: b. near Dublin, Ireland, 25 Dec. 1829; d. St. Louis, Mo., 24 Sept. 1892. He went to Boston at 18 and the next year organized Gilmore's band. In 1869 he arranged the Peace Jubilee in Boston, and in 1872 the World's Jubilee, in Boston also. Later he formed the noted 22d Regiment band in New York, which gave concerts in the United States and made a European concert tour in 1882. He composed but little; an anthem entitled 'Columbia,' intended to serve as the country's national hymn, was his only work of note.

Gilmour, gĭl'moor, **Richard,** American Roman Catholic prelate: b. Glasgow, Scotland, 28 Sept. 1824; d. St. Augustine, Fla., 13 April 1891. He was ordained priest in 1852, and after various pastorates, including those at Portsmouth, Ironton, Cincinnati, and Dayton, was consecrated bishop of Cleveland in 1872. His administration of the diocese was markedly efficient, and particularly so along the lines of Roman Catholic education. He published a Bible history, a series of 'Catholic National Readers,' and other books, and in 1874 founded the 'Catholic Universe,' an influential journal.

Gilolo, jē-lō'lō, **Jilolo,** or **Halmahera,** an island of the Molucca group in the Indian Archipelago, belonging to the Netherlands; area 6,500 square miles; length 225 miles. It is of singular form, consisting of four peninsulas, radiating from a common centre, and having large bays between. It is rugged and mountainous, the mountains being volcanic. The original inhabitants have been gradually pressed into the interior by the Malays. Pop. 120,000.

Gilpin, gĭl'pĭn, **Henry Dilwood,** American lawyer: b. Lancaster, England, 14 April 1801; d. Philadelphia 29 Jan. 1860. He was graduated from the University of Pennsylvania, studied law and became State attorney in 1822. He was United States attorney for Pennsylvania in 1832, and attorney-general of the United States 1840–1. Besides 'Reports of Cases' he published 'Opinions of the Attorney-Generals of the United States from the Beginning of the Government to 1841' (1841) and edited 'The Papers of James Madison' (1846).

Gilpin, John, the hero of a well known ballad by William Cowper, entitled 'The Diverting History of John Gilpin, Showing how he Went Further than he Intended and Came Safe Home Again.' It was first printed anonymously in 1782, and published with the author's name in 1785.

Gilsonite, gil'sōn-īt, also called **Uintahite,** a natural hydrocarbon compound; a pure hard variety of asphaltum. It is very brittle, a lustrous black in color and fuses. It is used for a great variety of purposes in the arts, for instance in the manufacture of varnishes. Mixed with heavy California maltha or with petroleum residuum it has been used as a paving cement. The principal deposits in the United States are near Soldiers' Summit in Uintah County, Utah. The total output in 1902 was 4,052 short tons, valued at $61,182.

Gilthead, or **Gilteye,** English names for a small and beautiful sea-bream (*Chrysophrys aurata*), with conspicuous gold-colored spots over the eyes. It abounds in the Mediterranean, and ranges northward to England and southward to the Cape of Good Hope. This was one of the fishes kept and fattened by the Romans in their vivaria. Several other species are known in the Far East, one species (*C. berda*), being one of the favorite fishes of Madras under the name of black rock-cod.

Gin (more properly Geneva, from Fr. *genièvre,* «juniper»), a compounded spirit, prepared by redistilling plain spirit with juniper berries, coriander seeds, angelica root, etc., or by adding various essential oils to rectified spirit. The gin produced by distilling possesses a much more delicate flavor than that produced by mixing or compounding. The strength of gin varies from proof to 50 under proof. It was first made in Holland, notably at Schiedam.

As used in machinery the word gin is an abbreviation of engine and is used of Whitney's device for separating cotton-seed from the fibre and more generally of a portable hoisting machine whose frame is a tripod, one leg being movable so as to vary its angle of elevation, and thus determine the height of the apex. The other two legs preserve their relative distance

and form standards for the drum, round which the rope is wound by power applied to the handspikes. For heavy weights a fall and tackle is used; and for hoisting a bucket from a well or mine, simply a couple of pulleys to change the direction of motion of the rope. One pulley is suspended from the apex, and the other attached between the two permanent legs, so as to change the rope to a horizontal position, for the attachment of a draught horse.

Gin, Cotton. See COTTON; COTTON GIN.

Ginatilan, hē-nä-tē'län, Philippines, a town on the western coast of Cebu, at the mouth of the Rio Ginatilan. There is valuable timber in the vicinity. Pop. (1900) 12,144.

Ginevra, gĭ-nev'ra, or jē-nĕv'ra, the title of a noted narrative poem by Samuel Rogers. It is named for its heroine whose affecting story is also recounted in 'The Mistletoe Bough,' a ballad by Thomas Haynes Bayly.

Gingal. See JINGAL.

Ginger, in botany, *Zingiber officinale*, common or narrow-leaved ginger, and in ordinary language the rhizomes of the same plant, which has subsessile linear lanceolate smooth leaves, oblong spikes, acute bracts, and a three-lobed lip. It is a native of India, but is cultivated in most tropical countries. A broad-leaved ginger, *Z. zerumbet*, also a native of India, is used externally for cataplasms and fomentations, but is not eaten. The pieces or races of the rootstocks are usually from 2 to 4 inches long, branched, flat, and of a pale buff color. Ginger is known in commerce under two forms, coated and uncoated or scraped; the latter is deprived of its epidermis when in the green state, and sold as white ginger. The chief varieties imported into the United States are Jamaica, Cochin, Bengal, Japan, and African. The first three are scraped gingers, and of these Jamaica is the most esteemed owing to its color and flavor. Ginger is an agreeable aromatic, and a valuable stomachic; but is more largely used as a condiment than as a medicine. Preserved ginger, imported from China in jars, consists of the young rhizomes boiled in syrup. Ground ginger is frequently adulterated with sago flour, wheat flour, ground rice, and arrowroot.

Ginger Ale or **Beer,** an effervescent drink, made of ginger, water, sugar, cream of tartar (or lemon juice), etc. A well-known method is by pouring a gallon of boiling water over ¾ pound of loaf-sugar, 1½ ounces of sliced ginger, and the peel of one lemon, and after allowing the mixture to cool till it is milk-warm adding the juice of a lemon and a spoonful of yeast.

Gingerbread Tree. See DOOM PALM.

Ging'ham (*ali, gingamo*, from Guingamp, a town in Brittany, where the fabric was woven), a kind of cotton, the manufacture of which was introduced into Great Britain through France from India. It is distinguished from calico by having the colors woven in with the fabric, not printed on it. The patterns are various; sometimes fancy designs, sometimes checkered, and sometimes striped.

Gingili (jĭn'jĭ-lĭ) **Oil,** a name often given to the bland fixed oil obtained by expression from the seeds of *Sesamum Indicum*. It is used medicinally as laxative or mild purgative. See SESAME.

Ging'ko, the Japanese name of a genus of trees (*Salisburia*), of the yew group of conifers. The *S. adiantifolia* (*Gingko biloba* of Linnæus), the only species, is a tree which sometimes attains a height of nearly 100 feet. Its head is conical, and the branches are usually horizontal. The leaves are compound, with from two to four thick coriaceous leaflets marked with small longitudinal nervures, their resemblance to the maidenhair fern giving it its English name of maidenhair tree. It is a native of China and Japan, and was first introduced into Europe in 1754. Its fruit, which is of the size of a small plum, has a pulp with a disagreeable odor of butyric acid and enclosing a kernel which, when roasted, may be used as food, having a taste like that of maize. It is largely eaten throughout China and Japan. The Japanese consider the tree sacred and plant it near their temples. The gingko is considerably used as an ornamental tree in England and in the United States. It flourishes best in the shade, in a deep and somewhat moist soil.

Ginigaran, hē-nē-gä'rän, Philippines, a pueblo of the province of Negros Occidental, at the mouth of the Ginigaran River on the east shore of Guimarás Strait, 29 miles south of Bacólod; it is also on the West Coast road. Pop. 13,620.

Ginseng, jĭn'sĕng, several species of herbs of the genus *Panax*, natural order *Araliaceæ*. The most noted species are *Panax ginseng*, a native of China, and *P. quinquefolium*, of America. These two species so closely resemble each other that the discovery of the latter near Montreal, Quebec, in 1716, was based upon a description of the former. The plants grow about 18 inches tall, bear five long-petioled nearly smooth leaves arising from one point, whence also arises the flower-stem bearing an umbel of small flowers from which develop conspicuous scarlet, generally two-seeded berries. The light yellow root, especially of the former species, is used by the Chinese for every conceivable domestic and medicinal use and specimens resembling the human body often command their weight in gold because of supposed occult virtues. Neither species, however, is considered by American or British physicians to have any pronounced medical qualities. The Asiatic species has long been cultivated in China and Korea.

Shortly after the discovery of the American species a shipment of the wild root was made to China and soon a trade was established. Since the plant has a natural range from the valley of the St. Lawrence to the mountains of Georgia and westward to the eastern bank of the Mississippi, the wild supply of roots long met the demand. In 1858 the price was 52 cents a pound; in 1902, $5.55, the advance being largely due to the decrease of the native supply. In the latter year many lots of northern root (considered always better than southern) sold for $8.00 or even more. The advancing price led to many attempts to cultivate the plant, but until about 1885 none were reported successful. Then George Stanton, of Apulia, N. Y., succeeded by growing the plant in beds prepared in the forest and later under lath sheds. These methods have led to the establishment of American ginseng growing. Cultivated ginseng has commanded about 20 per cent more than wild root from the same locality.

The plants thrive best in a well-drained, rather loose soil, well supplied with humus, potash and phosphoric acid, but not with nitrogenous material. Little has been done to improve the plant, but the time required to mature a crop of roots can probably be shortened considerably and the size of the root increased. In 1902 most growers calculated upon five years as necessary to mature a crop, but at the price of $2.50 a pound they figured upon making a profit under reasonably favorable conditions. The atrocious prices paid for plants and seed during 1898–1903 were largely due to speculation, an exaggerated estimate of the demand in China, which is almost the sole market, and to the novelty of the industry, and hence the scarcity of plants and seed. Consult: Revised edition of Bulletin No. 16, Division of Botany, United States Department of Agriculture (Washington, D. C.); Kains, 'Ginseng' (New York 1902).

Ginx's (gĭnks'ĕz) **Baby,** the title of a famous book by John Edward Jenkins. It is a satire on the English poor-laws and the administration of sectarian charitable associations, and was published anonymously in London in 1871. It speedily ran through many editions, was republished in the United States, and excited warm controversy in the press and even in parliament. It was followed by satires on other phases of social economy, but none of the other works of this author attained such a vogue or exerted such an undoubted influence upon the direction of social reforms.

Giobertine (jō-bĕrt'ĭn) **Tincture,** a preparation for restoring writings which have become illegible through age, or faded pictures. The inventor of it was Giovanni Antonio Gioberti, a native of Piedmont (1761–1834). This invention has been invaluable in restoring the original writing of palimpsests. See PALIMPSEST.

Gioja, jō'yä, **Flavio,** Italian mariner: **b.** Pasitano, near Amalfi, in the latter part of the 13th century. He is said to be the inventor of the mariner's compass, of which he made use in 1302–3. The tendency of the loadstone to turn toward the north was known before his day, but the compass then in use consisted only of a magnetized reed floating upon cork in a vessel of water. Gioja invented the plan of suspending it on a pivot, thus leaving it free to move in any direction, whereby observations were rendered both easier and more exact.

Giorgione, jŏr-jō'nĕ (easel name of GIORGIO BARBARELLI or BARBARELLA), Italian painter: b. Castelfranco 1477; d. Venice 1511. He was a pupil of Giovanni Bellino, and painted history and portraits. He was one of the most celebrated of the Venetian school, was a fellow student of Titian, whom he might have rivaled, had he not died of the plague in early life, while Titian lived for nearly a century. To him Venetian painting owes much of its marvelous technique, and by his example in the use of pigments and glazings he set an example many followed; he has had more pictures by other hands attributed to him (nearly a hundred) than any other Italian master. Even connoisseurs have been deceived by the depth and richness of coloring, the luminosity of aërial perspective, which his imitators had learned from him too well. Yet there are not more than 12 authentic pictures by Giorgione, and these are dispersed among the public galleries of Florence, London, Madrid, Dresden and Vienna.

Giotto, jŏt'tō (called GIOTTO DI BONDONE), Italian painter and architect: b. Vespignano, near Florence, about 1266; d. Florence 8 Jan. 1337. He was the son of a peasant, and was employed, it is said, in tending cattle. But having been once seen by Cimabue, as he was drawing figures of his sheep upon a piece of slate with a stone, that artist obtained leave from his father to take him with him, carried him to Florence, and taught him painting. This may be a mere story, but at any rate his first teacher was Cimabue. His natural talent, and especially the gracefulness so peculiar to him, developed so rapidly that he soon surpassed all contemporary artists. He represented the human figure in his pieces with truth and nature, and excelled in the dignity of his figures, a pleasing arrangement of them, and a regard to correct proportions and natural disposition of the drapery. His earliest extant works are mural paintings in the Church of St. Francis at Assisi, executed before the end of the 13th century. He was now called to Rome, and after painting various works there he went to Padua, in 1303, and adorned the chapel of the Annunciata dell' Arena with a series of famous frescoes, including 38 subjects, disposed in three rows, on the sides of the chapel and the front of the chancel wall, with a vast representation of the 'Last Judgment' filling the west end. Dante was his guest at Padua in 1306, and he is celebrated in the great poet's 'Divina Commedia.' He was also a friend of Petrarch. He worked also at Milan, Verona, Ravenna, Rimini, and Arezzo. In 1330–33 he was at Naples, and in 1334 was appointed master of the cathedral works and other undertakings at Florence, where he designed the celebrated Campanile, a structure finished by his scholar and godson, Taddeo Gaddi. Besides the frescoes at Assisi and Padua, comparatively few works of Giotto are extant. Among his most celebrated pieces is the 'Navicella' (ship) at Rome (a picture of 'Peter Walking upon the Waves,' in mosaic). The National Gallery possesses a 'Coronation of the Virgin' painted in tempera, on wood. "The influence of Giotto was profoundly felt over the greater part of Italy. His example caused a revolution in art, the effects of which are traceable into the 15th century." Many anecdotes of more or less authenticity are told regarding this painter. On one occasion, when asked for a sample of his art to show the Pope, Giotto is said to have drawn a perfect circle with a single stroke; whence "round as the O of Giotto" became proverbial. See Crowe and Cavalcaselle, 'History of Painting in Italy' (1864–6); Janitscheck, 'Die Kunstlehre Dantes und Giottos Kunst' (1892); Ruskin, 'Giotto, and his Works in Padua' (1854–60); Zimmermann, 'Giotto' (1899); Thiorle, 'Giotto' (1902).

Gippsland, gĭps'lănd, Australia, one of the four important districts into which Victoria is divided, so named after an early governor. It forms the southeast portion of Victoria, and has an area of 13,898 square miles. Its length from west to east is 250 miles, and mean breadth about 80. It was originally called Caledonia Australis by Macmillan, its first explorer (1839).

Gipsies, jĭp'sĭz (from Egyptians, the name by which they were called in the English stat-

utes), a wandering nation. They are called by the French Bohémiens, from the belief that they were Hussites driven from their country; in Switzerland, the Netherlands, and the Black Forest they go under the names of Heiden (Pagans); in North Germany, Denmark, and Sweden they are called Tater (Tartars). The name they most frequently pass under in Germany is Zigeuner, which is not unlike the Italian Zingaro or Zingano, the Spanish Zingaro or Gitano, the Hungarian Cigany, the Turkish Tschinganeh. They call themselves Rom, whence Romani, or Romany, the name of their language. The number of gipsies in Europe is roughly set at perhaps 750,000. Of this number about 200,000 are in Rumania; 95,000 in Austria-Hungary; 120,000 in European Turkey; 40,000 in Spain; 40,000 spread over Germany, France, and Italy; 18,000 in Great Britain; and the remainder scattered over other countries. The main body of their language is the same throughout Europe, and even now has a close affinity with the dialects of Hindustan, though it is mixed with a great number of words and expressions borrowed from the races among whom they have sojourned. The gipsies are distinct from the people among whom they dwell, especially in their bodily appearance as a race and in their language. They are slight and agile in frame, though sometimes tall of stature. Their skin is tawny, or olive-colored, their eyes large, dark and brilliant. They have long hair, raven-black, and sometimes ringletted. The mouth of the gipsy is small and finely shaped, and the teeth of pearly whiteness. Scientific men have come to the conclusion that these wanderers are neither of European nor of African origin, but are a remnant of some obscure Indian tribe. This ethnological conclusion is borne out by the fact that their language is undoubtedly derived from the Sanskrit, although intermingled with Oriental terms and inflections appear words of Greek, Slavic, Rumanian, Magyar, German, French, and English origin.

Their history is curious and interesting. Organized gipsy bands first appeared in Europe at the beginning of the 15th century, and in Italy their number in 1422 was computed at 14,000. Five years later they made their first appearance in Paris, saying that they were Christians of Lower Egypt, driven to take refuge in Europe from the Saracens, and had recently left Bohemia. They professed to be performing a penance imposed upon them by Pope Martin V., who, after hearing their confessions of sins committed during their travels, had ordered them to wander over the earth for seven years without taking rest on beds. They were permitted to settle outside the city of Paris, but when they began to practise palmistry and fortune-telling the archbishop had them driven away, and excommunicated the vast number of citizens who had consulted them. Other bands succeeded the 120 gipsies who first made their appearance in Paris: these latter had crossed the channel for England. They were great thieves and in every European country they visited were regarded with disfavor. In vain laws were passed against them. Francis I. of France ordered them to leave the country on pain of being sent to the galleys without trial. The States-General of Orleans condemned them to perpetual banishment. In the middle of the 15th century Pope Pius II. cites them as thieves from the Caucasus. In 1492 Spain exiled them and renewed the decree 100 years later. Elizabeth of England followed Henry VIII. in uttering a proclamation against them. In Scotland they were sheltered and protected, and John Faw, Lord and Earl of Little Egypt, was empowered by royal writ to exercise authority over his gipsy subjects. Germany tried to eliminate them, and Maria Theresa in 1768 undertook to settle them as peasants on the land. This attempt was not successful, but Joseph II., by severe measures induced many of them to settle, practise trades, and have their children educated. Though their number in Europe must be estimated at three quarters of a million they are less a vagrant class than formerly, a fact which is due largely to the stricter policing of the rural districts, and the increase of intelligence among the peasantry, and among the gipsies themselves. Gipsies have never settled in the United States as vagrant communities.

Gipsy-moth, a large moth (*Porthetria*, or *Ocneria, dispar*), of the family *Liparidæ*, imported into Massachusetts, in 1868, where it soon became a pest by defoliating shade-trees: and up to 1900 it had cost the commonwealth $1,550,000. The sexes of the moth differ greatly, the male expanding only about one and a half to two inches, while the female measures across its expanded wings two and a half inches; the female is spotted brownish, and the male is white, marked with black lines. The former lays her eggs in masses to the number of 500 wherever convenient, covering them with hairs and scales from her own body. The females have such heavy abdomens that the wings are inadequate for flight, hence the insect, owing to the measures which have been employed to prevent its artificial carriage has not spread far beyond the place where originally introduced, near Malden. The caterpillar measures when mature about 1.5 inches, is white, with black markings, and furnished with long hairs. It is arboreal and capable of being most troublesome on shade, forest, and fruit-trees, but when abundant it feeds and develops on any form of vegetation. A single generation is produced annually. The best means of combating it are spraying with arsenical mixtures, the collection of the cocoons and egg-masses and destroying them: the scraping of loose bark from trees, thus destroying the young and depriving them of hiding places; also the destruction of the eggs by means of oily substances, and the trapping of the larvæ with strips of burlap placed about the infested trees. Consult: 'The Gipsy Moth,' by Forbush & Fernald (Boston 1896); Howard, 'The Gipsy Moth in America,' Department of Agriculture, (Washington, 1897).

Giraffe, jĭ-răf', or **Camelopard**, the tallest of mammals (*Giraffa camelopardalis*), the type of a family of ruminants (*Giraffidæ*), intermediate between deer and antelopes, and also containing the okapi (q.v.). It is a native of Africa south of the Sahara, but is now to be found only in the interior, remote from civilization and where there are brushy plains or open forest, and is fast decreasing. It occurs generally in small herds of from 5 to 40. It feeds on the leaves and small branches of trees, especially mimosas, which, in districts where the animals abound are kept cropped to a convenient height

for browsing. Its general aspect is remarkable from the height of the foreparts and great elongation of the neck, the head being sometimes 18 feet from the ground. The number of vertebræ in the neck, however (seven), is not greater than in other quadrupeds, and it has no extraordinary flexibility, although its form and movements are very graceful. The length, therefore, is due to the elongation of each cervical vertebra. The body is short, and the back slopes from the shoulder to the tail; yet the greater height of the foreparts is not entirely owing to the greater length of the fore-legs, but to the neural processes of the vertebræ, which form a basis for the support of the neck and head. The head is long, capable of a wide range of movements, and the upper lip is projecting and somewhat prehensile, while the tongue is remarkably capable of elongation, and can be thrust far out of the mouth, and employed to grasp and take up even very small objects; it is said that its tip can be so tapered as to enter the ring of a very small key. The usefulness of such an organ for drawing in leaves and branchlets to the mouth is obvious. The giraffe adroitly picks off the leaves of acacias and other thorny plants, without taking the thorns into its mouth. The dentition of the giraffe agrees with that of antelopes, sheep, and oxen; the upper jaw of the male is destitute of the canine teeth which are present in the male of many deer.

Anatomically the most remarkable feature of the giraffe is the presence in both sexes of two protuberances between the ears, generally described as horns, but very different from the horns of other animals, and each consisting of a permanent bone united to the skull by an obvious suture, covered with skin and hair, and terminated by long hard bristles. These long outgrowths correspond to the bony core of the antelope's horn or to the pedicel of the antler in the deer. There is also a projection on the forehead, which, in the giraffes of South Africa, is so elongated as to indicate a separate species (*G. australis*) in the opinion of recent naturalists. If this view be accepted then the name *camelopardalis* applies properly only to the giraffes now to be found only in Somaliland. Moreover, Sir H. Johnston has reported that there exists in Uganda a very brilliantly colored form which has five horny protuberances, instead of three, upon the head; and when better known may prove to be in a new genus as well as of a novel species. The hair of the giraffe is short and smooth, with a short mane on the neck, and a tuft on the end of the tail. The color is reddish-brown in irregular areas sharply marked off by white borders, like the mortar between brick-work; but there is much variation in tint as well as pattern. A few extinct forms are found fossil in the Pliocene beds of China, India, and Greece, of which *Samotherium* and *Hallidotherium* are prominent examples; they had a shorter neck and legs and more bovine appearance than their successors, and the males alone have horns.

The giraffe is an inoffensive animal, and generally seeks safety, if possible, in flight, although it is capable of making a stout resistance, and is said to beat off the lion by kicking with its hind-legs, discharging a storm of kicks with extraordinary rapidity. It is not easily overtaken even by a fleet horse, and has greatly the advantage of a horse on uneven and broken ground. Its pace is described as an amble, the legs of the same side moving at the same time. The giraffe was known to the ancients, and was exhibited in Roman spectacles. Representations of it appear among Egyptian antiquities. It has been supposed to be the zemer of the Jews, translated chamois in the English Bible (Deut. xiv. 5).

It is one of the costliest and most uncommon animals in menageries, although in former years they were kept and bred in Europe. The flesh is excellent meat, and the hide is thick and makes good leather. Consult: Beddard, 'Mammalia' (1902), and the writings of naturalists and sportsmen in Africa, especially Johnston, Baker, Bryden, Holub, and Selous.

Giralda, hē-räl'dä (Spanish *girar,* "to turn round"), a weathercock in the form of a figure or statue. It is pre-eminently applied to the weathercock, and from that to the Moorish tower or minaret (part of the cathedral) which it surmounts at Seville, Spain. The figure in this weathercock is that of Faith, which turns round to face every wind and storm. In the copy of the tower of Seville cathedral which appears in Madison Square Garden, N. Y., the figure of Faith is replaced by that of Diana.

Girard, jĭ-rärd', **Charles,** American naturalist: b. Mülhausen, France, 1822. In 1839 he was a pupil of Agassiz, at Neufchâtel, Switzerland, and soon became one of his assistants, accompanying him to America, and remaining his assistant until 1850. He was attached to the Smithsonian Institution 1850–9, and has published: 'Herpetology of the United States Exploring Expedition under Capt. Wilkes' (1858); and many professional articles and monographs.

Girard, zhē-rär, **Marc Amable,** Canadian politician: b. Varennes, P. Q., 25 April 1822; d. Winnipeg 10 Sept. 1892. In 1871 he was admitted to the bar of Manitoba, in whose politics he was long active as treasurer (1870–2), premier (1874), and later secretary, minister of agriculture, and president of the council. In 1871 he became a senator of the Dominion of Canada and in 1872 a member of the executive council for the Northwest Territories.

Girard, Philippe Henri de, fē-lēp ŏṅ-rē dē, French inventor: b. Lourmarin, France, 1 Feb. 1775; d. Paris 26 Aug. 1845. He was a man of versatile, scientific tastes, but concentrated his powers on mechanics. When Napoleon offered 1,000,000 francs as a prize for a machine that would spin flax, Girard invented the machine, but the fall of Napoleon deprived him of the reward. In 1815 he settled in Austria, built a flax-mill at Hirtenberg, and inaugurated steamboat service on the Danube. At the invitation of the Russian czar he went to Poland in 1825 and established a flax-mill which became the centre of the village of Girardou.

Girard, jĭ-rärd', **Stephen,** American philanthropist: b. Bordeaux, France, 24 May 1750; d. Philadelphia 26 Dec. 1831. In 1769 he settled in Philadelphia and engaged in various trades. Later, in 1780–90, he formed a partnership with his brother John and for some years continued a most successful West Indian and coastwise trade. He became interested in the first United States Bank in Philadelphia, and in 1812 had

purchased the controlling interest and building. The bank continued to do business under the name of the Girard Bank, and soon became one of the foremost financial institutions of the country. He was a man of peculiar habits, ill-tempered and repellent in manner, but with all, a man uncommonly generous in his charities, chief among which was the $5,000,000 left for the erection and maintenance of a college for male white orphans. During the rage of yellow fever in Philadelphia he was ever present in relieving the afflicted, both by his free giving and by his personal care.

Girard, Kan., a city and county-seat of Crawford County, on the Atchison, T. & S. F., and St. Louis & S. F. R.R.'s. Its situation is well adapted to agricultural pursuits. It has 6 churches, 2 banks, and 3 public schools. The industries include zinc smelting, stove manufacturing, and flour-mills. The city owns its own water-works. Pop. (1900) 2,473.

Girard College, Philadelphia, Pa., an institution for the education of poor white orphan boys; founded under the will of Stephen Girard, and opened 1 Jan. 1848. By a provision in the will no ecclesiastic, missionary, or minister of any sect whatever is to have any connection with the college. At the close of the school year 1900 it reported: Professors and instructors, 67; students, 1,731; volumes in the library, 16,800; productive funds, $15,938,293; income, $1,000,000; number of graduates, 4,754; president, A. H. Fetterolf, Ph.D., LL.D. The total value of the college property exceeds $16,000,000.

Girardin, MADAME **Delphine Gayde,** dĕl-fēn gād zhē-rär-dăṅ, French poet and novelist: b. Aix-la-Chapelle, Rhine Province, Prussia, 26 Jan. 1804; d. Paris 29 June 1855. Carefully educated by her mother, Sophie Gay (q.v.), she won fame with her poetry at the age of 15, an academic prize at 18, and a royal pension at 20. In 1831 she married the eminent journalist M. Emile de Girardin, and began now to turn her attention to prose fiction, producing successively: 'Le Lorgnon'; 'Le Marquis de Pontanges'; 'La Canne de M. de Balzac'; 'Il ne faut pas jouer avec Douleur'; and 'Marguerite.' She also contributed to the 'Presse,' conducted by her husband, her 'Lettres parisiennes,' which, under the pseudonym of the "VICOMTE DE LAUNAY," attracted great and deserved admiration by their wit and liveliness. As a writer for the stage Madame de Girardin obtained some distinction, two of her most successful pieces being: 'Lady Tartuffe' and 'La joie fait peur.' She also composed two tragedies, 'Judith' and 'Cleopatra,' for the celebrated Rachel; and a little piece by her, 'Le Chapeau de l'Horloger,' became a popular farce in England under its English title of 'The Clockmaker's Hat.'

Girardin, Emile de, ā mēl dē, French journalist and politician: b. Paris 22 June 1806; d. there 27 April 1881. He bore the name of Delamothe till 1827, when he assumed that of his father, who acknowledged him in 1847; and his first attempt in literature was a novel, 'Emile,' in which he pleaded the cause of adulterine children. After the July revolution of 1830 he established the 'Journal des Connaissances Utiles,' and in 1836 founded the 'Presse,' an Orleanist journal with Conservative leanings. Its rivals accused it of being subsidized by the government, and one of the unfortunate results of the quarrels thus fastened on Girardin was his duel with Armand Carrel, editor of the 'National,' in which the latter fell. He promoted Louis Napoleon's election to the presidency, and afterward became a Socialist. In 1856 he sold his share of the 'Presse,' but became its editor again in 1862, eventually abandoning it for the direction of the 'Liberté,' which he maintained till 1870. During the Commune he proposed a scheme for splitting up the republic into 15 federal states. In 1874, however, he founded the 'France,' and both in its pages and in the 'Petit Journal' supported the republic. He wrote a few pieces for the stage; his political ideas he gave to the world in a host of brochures.

Girder, a beam, of wood or metal, spanning the distance from wall to wall or pier to pier, and used to support a superstructure or superincumbent weight, as a floor, the pathway of a bridge, etc. Girders are often compound, the timbers being scarfed together and stayed by truss-work, or fished at the joint. The ends of the girder rest on the wall or pier to an extent varying according to the span; thus for a girder of 10 foot span, the bearing at each end should be 7 inches; for a 20-foot span, 14 inches. The ends rest on templates. Girders are of various sorts, according to the purpose for which they are required. A sandwich girder is one which is composed of two wooden beams with an iron flitch plate between, all bolted together. See BRIDGE BUILDING; BUILDING.

Gir'dler, a small American longicorn beetle (*Oncideres cingulatus*), which in August lays an egg in a hole bored into a twig of a hickory, pear, or other tree, and then gnaws a deep groove below the egg, thus girdling the twig. This kills the extremity and provides a supply of dead wood as food for the grub which is soon hatched. The grub eats all the woody tissue, and within the concealing shell of bark remaining, pupates and passes the winter, becoming a full beetle and emerging the following spring. When this insect is numerous it may do serious damage to forests and orchards.

Girls' Clubs, societies with a membership of girls banded together for recreation, study, mutual helpfulness, etc. Among girls there is apparently less spontaneity than among boys in regard to the formation of clubs, but large numbers of girls are found in clubs organized and to a greater or less degree supervised by older persons. In women's clubs so called, large numbers of girls are found either as regular members or in a junior branch or department. Some large societies, such as the Young Women's Christian Association, do not apply the name club to any of their branches, and could not accurately do so, and yet the opportunities they afford to girls, for entertainment, self-improvement and social intercourse, and the use of rooms for gatherings, reading, and writing, etc., afford to members what is largely equivalent to club membership, a fact appreciated by the girls themselves, who sometimes give as a reason for joining such societies, the wish to be connected with "a club." Many girls are found in the large organization known as King's Daughters and Sons, especially in the junior circles. In such bands, religious or benevolent features predominate, but the social element

is cultivated in a greater or less degree. The Girls' Friendly Society is also largely of a religious nature, but in addition to church and missionary work, it provides opportunities for recreation and for the mental and industrial training of its members. Instruction in hygiene is an important feature, and music receives much attention. The aim of the society is to encourage purity of life, dutifulness to parents, faithfulness to employers, and thrift; and to cultivate a spirit of fellowship and kindliness. It ensures the privileges of the society to its members wherever they may be, by giving them an introduction from one branch to another. The parent society was started in England in 1875 (at a time when much interest was shown in "rescue work") with the central idea of helping young women along preventive rather than reformatory lines. The form of organization follows as far as possible that of the Church of England, being diocesan and parochial. Any girl of good character, 12 years of age or over may become a member, and younger girls may become probationers or candidates. Associate members must be communicants. This society now extends wherever the English language is spoken and is the largest society of girls and women in existence, numbering about 300. The Girls' Friendly Society in America is under the auspices of the Protestant Episcopal Church. Branches were started in Lowell, Mass., and in Baltimore, Md., soon after the organization of the English society, and a central council was formed in 1886. On 1 Oct. 1902 the society reported 435 branches, in 54 dioceses; and a total membership (including associates, probationers, candidates, etc.) of 25,399. There are six holiday houses, belonging respectively to the diocesan branches of Massachusetts, New York, Pennsylvania, Rhode Island, and New Jersey. The organs of the society are two monthly periodicals, 'The Girls' Friendly Magazine,' and 'The Associates' Record.' The central office is in the Church Missions House, New York. Some individual churches maintain girls' clubs as a part of their parish work. The club connected with St. Bartholomew's Church, New York, has a club-room, baths, classes of various kinds, and a mutual benefit fund. In the social, university, and college settlements in large cities throughout the United States, clubs for girls generally constitute an important feature of the work.

The use of the word "girl" in connection with working-girls' clubs is somewhat vague, as the term is very elastic in its application. In most working-women's clubs girls are admitted who have passed the age of 14, but in some cases there are also junior clubs for the younger girls. These "sub-clubs" are to some extent under the supervision of the older members, but usually have their own officers and constitution. The State and city associations of working-girls' clubs secure for the individual clubs belonging to them enlarged advantages and more effective working. The results of united effort are illustrated by the success of the movement for the early closing of stores in Boston in 1896–7, a step due in great part to clubs having a membership largely drawn from girls in stores and factories. One of the objects of the Massachusetts association is to assist clubs in obtaining the services of good teachers, physicians, and lecturers. Among the subjects very frequently taught in the classes connected with working-girls' clubs are plain sewing and embroidery, millinery, cooking, gymnastics, and singing. Lessons in English literature, elocution, French, German, stenography, drawing, modeling, and painting are also offered to many club members. In some of the clubs the teachers are paid, and in others they contribute their services. Besides the more formal lessons, talks are often given to club girls on hygiene, nursing, morals, manners, etc.; and concerts, lectures, and readings, with "evenings of travel" fill many of the evenings devoted to entertainment. Outings of various kinds form a summer feature in many clubs, and vacations are often made possible at cheaper rates than could otherwise be obtained by the members. Large clubs or associations conduct vacation houses at the seashore or in the country. The pleasures and privileges connected with club life form the brightest and most hopeful element in the life of many a self-supporting girl. See BOYS' CLUBS; CLUBS; KING'S DAUGHTERS AND SONS, INTERNATIONAL ORDER OF; LEND A HAND CLUBS; WOMEN'S CLUBS; WORKING WOMEN'S CLUBS.

Girls' Friendly Society. See GIRLS' CLUBS.

Gironde, zhē-rônd, France, a department, bounded north by the estuary which gives it its name, and the department of the Charente; east by Dordogne and Lotet-Garonne; south by Landes; and west by the Bay of Biscay; area, 4,140 square miles. The whole department, with exception of the west, which sends its waters either directly to the coast or the long series of lagoons by which it is lined, belongs to the basin of the Gironde, which is formed in its interior by the junction of the Dordogne and Garonne. The only other streams deserving of notice are the Leyre, which discharges itself into the most southern lagoon; the Ciron, a left affluent of the Dordogne; and the Isle, with its tributary Dronne. The quantity of waste land is very great, amounting to more than one third; while the arable land is rather less than one fourth of the whole surface. Of the remainder about one seventh is occupied by vineyards, and one ninth under wood. The great staple of production is wine. The most celebrated wines are Médoc, Graves, Côtes, Palus, and Entre-deux-Mers. (See WINES.) The trade, which has its centre at Bordeaux, is very important. The principal exports are wine, brandy, corn, flour, fruit, rosin, liqueurs, etc. For administrative purposes Gironde is divided into six arrondissements — Bordeaux, Bazas, Blaye, Lesparre, Libourne, and La Réole. The capital is Bordeaux (q.v.). Pop. (1901) 821,131.

Girondist, jĭ-rŏn'dĭst, or **Girondin,** the name of a great political party in France; one of the most powerful factors in the earlier part of the first French Revolution. When the Legislative Assembly met in 1791, it contained representatives of the upper, the middle, and the lower classes. The Girondists were the party of the middle classes, and were republican in sentiment, but suffered from the lack of a definite policy. They obtained their designation from the fact that their most celebrated leaders, Vergniaud, Guadet, and Gensonné, were members for the department of the Gironde, originally lawyers in the law court of Bordeaux. Sometimes they were called Brissotins from Brissot, their

most eloquent leader. They were the most powerful party in the Assembly, and for a time shaped the policy of their country. When conservative Europe threatened France with invasion, the Girondists in April 1792, declared war, the Jacobins deprecating hostilities, as fearing the result. To overcome their monarchic rivals, the Girondists coquetted with the last-named party, and found that they had gained, not a servant, but a cruel and exacting master. The quarrel between the two arose after the massacres perpetrated in August and September 1792, and the extreme revolutionists ultimately prevailing, an armed mob on 31 May 1793 assailed the Convention, and demanded the imprisonment of 29 Girondist deputies. These were arrested on 2 June, and 21 of them were guillotined on 31 October. Others were subsequently put to death; a few escaping, reappeared in the Convention after the fall of Robespierre.

Girouard, Désiré, dā-zē-rā zhē-roo-är, Canadian jurist: b. Saint Timothée, P. Q., 7 July 1836. He practised his profession as a member of the Montreal bar 1860–95, and was a member of the Dominion Parliament for Jacques Cartier 1878–95. He carried the Deceased Wife's Sister Bill in 1882 and since 1895 has been a justice of the supreme court of Canada. He has published: 'Essai sur Lettres de Change' (1860); 'The Bill of Exchange Act' (1890); 'Lake St. Louis, Old and New and La Salle' (1893).

Girton (gėr'tọn) **College,** England, a noted college for women, instituted at Hitchin in 1869, but removed to Girton, near Cambridge, in 1873. The students, 110 in number, are admitted after an entrance examination; the ordinary course extends over three years, half of each year being spent in college. Degree certificates are granted for the B.A. of Cambridge University.

Girty, gėr'tĭ, **Simon,** American frontiersman and leader of the Indians: b. present Dauphin County, Pa., 1741; d. Canada 1818. He became a second lieutenant of Virginia militia, later an Indian interpreter, deserted to the English in 1776, was appointed an interpreter to the English Indian department, and was declared a traitor by the Pennsylvania legislature. His name was popularly associated with many Indian atrocities on the frontier, although it is likely that he was not at any time commander of a large force and that his prestige among the savages was much less than was supposed. He did, however, lead the Indians who attacked Dunlap's Station (1791) and Fort Jefferson (1791).

Gisborne, gĭz'bōrn, **Frederick Newton,** Canadian telegrapher: b. Broughton, Lancashire, England, 8 March 1824; d. 29 Aug. 1892. He went to Canada in 1845 and soon after engaged in telegraph work. He laid before the Nova Scotia authorities in 1850 a plan for telegraphic communication between Newfoundland and Ireland, and the first cable in America was laid by him in 1852, connecting Prince Edward Island and New Brunswick. In 1870 he was appointed superintendent of the Dominion Telegraph Signal Service.

Gismondite, jĭs'mŏn-dīt, or **Gismondine** (named after C. G. Gismondi, an Italian mineralogist), a monoclinic transparent or translucent mineral of vitreous lustre, its hardness 4.5; specific gravity 2.27; sometimes colorless, sometimes white, bluish-white, grayish, or reddish. It is optically biaxial. Composition: Silica, 35.88; alumina, 27.23; lime, 13.12; potassa, 2.85, and water, 21.10. Occurs in leucitic lava near Rome, and in Sicily.

Gissing, gĭs'sĭng, **George,** English novelist: b. Wakefield 22 Nov. 1857; d. Saint Jean de Luz, France, 28 Dec. 1903. In his stories he has made a remarkable study of the London masses, from the ranks of skilled labor to the most noisome human refuse of the slums, the result being half repulsive and wholly powerful. He has published: 'The Unclassed' (1884); 'Demos' (1886); 'Isabel Clarendon' (1886); 'Thyrza' (1887); 'A Life's Morning' (1888); 'The Nether World' (1889); 'The Emancipated' (1890); 'New Grub Street' (1891); 'Born in Exile' (1892); 'Denzil Quarrier' (1892); 'The Odd Women' (1893); 'In the Year of Jubilee' (1894); 'Eve's Ransom' (1895); 'The Whirlpool' (1897); 'Human Odds and Ends' (1897); 'The Town Traveler' (1898); 'Charles Dickens, a Critical Essay' (1898); 'The Crown of Life' (1899); 'Our Friend the Charlatan'; 'By the Ionian Sea' (1901).

Giulio Romano, joo'lē-ō rō-mä'nō, properly Giulio Pippi de Giannuzzi, Italian artist: b. Rome about 1492; d. Mantua 1 Nov. 1546. He assisted Raphael in several of the latter's works, including the 'Benefactors of the Church' in the Incendio del Borgo, and at Raphael's death completed the 'Battle of Constantine' and the 'Apparition of the Cross' in the Hall of Constantine in the Vatican. He built the Villa Madama, for which he painted a fresco of Polyphemus. In 1524 he accepted the invitation of the Duke of Mantua to undertake for him a series of architectural and pictorial works, and restored the Palazzo del Te, the cathedral, the streets, and a ducal palace at Marmirolo, near Mantua. Among other Mantuan works of his are the 'History of Troy,' in the castle, and 'Psyche,' 'Icarus,' and the 'Titans,' in the Te palace. In Bologna he designed the façade of the church of St. Petronio. Other works are the 'Martyrdom of Saint Stephen,' at Genoa; 'A Holy Family,' at Dresden; 'Mary and Jesus,' and the 'Madonna della Gatta.'

Gizeh, gē'zĕ, **Ghizeh,** or **Geezeh,** Egypt, a town on the left bank of the Nile, almost directly opposite Cairo. It was formerly an important place, beautified by palaces, but now forms a scene of ruins, amidst which the town is built. Five miles to the west are the great pyramids which have been named from this town, and here also is the famous Sphinx. Pop. about 11,500.

Gizzard, a stomach or a part of it or of the alimentary canal where it is unusually muscular and tough, so that it is able to crush or grind solid food. It is not possessed by animals whose food is soft or else is chewed before swallowing; and is best developed among seed-eating birds, which frequently swallow pebbles to assist the gizzard in its grinding work. Birds not accustomed to hard food, if compelled and able to adopt such a diet, will develop a serviceable gizzard. Various fishes, reptiles, crustaceans, insects, worms, and other invertebrates have gizzards. See *Digestive System* under Anatomy; Stomach.

Glacé Bay, Canada, town of Cape Breton Island and County, Province of Nova Scotia, on the extreme eastern seacoast and on the Sydney & Louisburg R.R., 17 miles east of Sydney.

Industries.— The town and the surrounding district are underlaid with vast deposits of coal and almost the entire population is dependent upon the coal mines, five of which are within the town limits and three others closely adjoining. The Dominion Coal Company employs about 5,000 persons and has a yearly output from their mines of over 4,000,000 tons.

Banks and Churches.— There are three banks, branches of those located in other cities. Nearly half the population is Roman Catholic, while the Presbyterians have great predominance over the Evangelical bodies.

Public and Educational Institutions.— Saint Joseph's Hospital is the second largest in America and one of the finest in the province. On Table Head, a bleak promontory one mile east of the town, Marconi completed in December 1902 his first transatlantic wireless telegraph and sent his first wireless messages across the Atlantic. The educational system consists of common and convent schools.

Government and Population.— The town was incorporated in 1901, its affairs being administered by a mayor, elected yearly, and a council of six members, elected for two years. The majority of the population are of Highland Scotch descent. Pop. Glacé Bay and surrounding collieries (1901) 6,945; (1905) 16,000.

Glacial Acetic Acid. See ACETIC ACID.

Glacial Drift. See DRIFT.

Glacial Period, or **Ice Age.** Over nearly all of the North American continent north of the 40th parallel and over a vast tract of the work of moving ice sheets or glaciers, rock surfaces have been ground and polished, great boulders have been carried long distances from the ledges whence they came, and the topography has characteristically rounded outlines. Since the marks of the ice chisel are plainly visible on hard rocks, and even on easily weathered rocks that have been protected by a thin layer of soil, it is evident that the ice finished its work recently.

Effects of Glaciation.— At the opening of the Glacial Period most of the land surface over which the ice advanced was covered by a deep soil grading through partly decayed rock into solid rock. Undoubtedly the ice did not level off the general surface of the country as much as has been supposed, but it wiped off the soil and partly decayed rock, rounded the outlines of hills, broadened north and south valleys and pushed before it or carried along a mass of detritus which formed whenever the ice stopped its advance, a terminal moraine. It is possible that clay and boulder were laid down in a thin sheet under the ice in places at least, forming what is known as boulder clay or till, near where was the southern edge of the ice, oval hills of clay and boulders known as drumlins. Other deposits were formed along the edge of the ice, from material worked over by water and known as stratified drift. These deposits include irregular hills of sand, gravel, and boulders, called kames, and long winding ridges of the same material called eskers. These latter are supposed to represent the filled channels of subglacial rivers. The irregular depressions known as pot holes, in a glaciated region, may sometimes represent where were isolated masses of ice when glacial detritus was deposited all around as the ice sheet retreated. It is in fact in the retreat of the ice front that topography was most modified, the terminal moraines, at each pause in the retreat, dammed river valleys, while the valleys were filled sometimes to a depth of hundreds of feet with detritus. Between the morainic dams in front and the ice in the rear, great lakes were formed, one of these, Lake Agassiz in Minnesota, the Dakotas, and Manitoba being 700 miles long from north to south. As the glacial retreat was recent, streams have not had time to cut down valleys and so a glaciated region is a region of lakes.

Cause and Duration of the Glacial Period.— Though several theories of the cause of the Glacial Period have been proposed, no one has received general acceptance, and the existence of Glacial periods in past geologic ages is still disputed. Probably there were Glacial periods before the Pleistocene. As to the Pleistocene, there is good evidence for believing that northern North America and probably Scandinavia were much elevated at the close of Tertiary time. This elevation of the land caused so heavy a snowfall that snow lay on the ground all the year round, and glaciers started. Another hypothesis, that of Croll, is that owing to variations in the eccentricity of the earth's orbit around the sun the hemisphere having winter when the earth was farthest from the sun, would for a period have protracted winters, and during this period great masses of ice might accumulate. Whatever the cause, the ice sheets formed and advanced. In North America three centres of glaciation are generally recognized, the Cordilleran, along the Rocky Mountains in British Columbia, whence the ice flowed eastward possibly 1,000 miles or more; the Keewatin, near Hudson Bay, whence the ice advanced southwest, south and southeast, reaching as far south as Iowa; and the Laurentide, north of the St. Lawrence River and in Labrador, whence the ice advanced over eastern Canada, New England, and the Central States as far west as the Mississippi River. These ice sheets did not advance simultaneously, but probably in the order named. Their retreat was accompanied or preceded by changes of level, until at the close of the Ice Age, during the so-called Champlain stage, or its equivalent, the Columbian, the ocean covered what is now dry land, and the climate was milder than now. The ice did not advance nor retreat steadily. Some geologists recognize in the Mississippi valley four or five advances and corresponding retreats, and speak of these as epochs or stages. The time since the close of the Ice Age has been variously estimated; average estimates being around 20,000 years. There is good evidence for believing that as much time elapsed between some of the advances of the ice. Hence it is sometimes said that we may be living to-day in an Inter-glacial Period. It is certain that man was in Europe in what is known as the Chellean Epoch, or early Pleistocene. He may have been in America at the same time, but no certain evidence of his presence has been found.

Bibliography.— Agassiz, 'Système Glaciale' (1847); Croll, 'Climate and Time' (1885);

Dawson, 'Canadian Ice Age' (1894); Bonney, 'Ice Work, Past and Present' (1896); Geikie, 'Great Ice Age' (1895); Heim and Penck, 'On the Ancient Glaciers of the Isar and Liuth' (1886); Wright, 'Ice Age in North America' (1890); Upham, 'Glacial Lake Agassiz' United States Geological Survey, Monograph XXV. See BOULDER CLAY; COLUMBIAN FORMATION; DILUVIUM, CHAMPLAIN STAGE; DRIFT; DRUMLIN; TILL.

SAMUEL SANFORD,
Engineering and Mining Journal.

Glacier Bear, a small gray or "blue" bear (*Ursus emmonsi*) of the St. Elias Alps, Alaska. See BEARS.

Glacier, a current of ice derived from snow. Water, changed into vapor by sun-heat and carried by the winds over frosty highlands, is crystallized into snow. Glaciers take their rise in regions which lie above the snow-line. Upon these regions, from their geographical position and elevation, the quantity of snow that falls exceeds the quantity melted and evaporated. The surplus, instead of accumulating indefinitely, is changed by the pressure of its weight into ice, which, though hard and apparently as brittle and inflexible as glass, flows down toward the sea in beautiful swaying undulating lines, as if soft like honey or tar. Thus the overburdened regions above the snow-line are relieved and a continuous circulation is maintained,— ocean water flying away through the air in the form of vapor, but in returning creeping along the ground in the form of ice, grinding and crushing the rocks that lie in its way, and leaving a heavier track than anything else that moves on the face of the earth.

In general a glacier flows like a river, and drains off snow as a river drains off rain. At different places it moves at different rates, not only along its cross-sections, but along its length and from surface to bottom, as friction and the declivity of its bed varies. The velocity of the swiftest parts of the largest glaciers of the Alps is about from one foot to three feet per day; of the smallest, about as many inches. The lower central part of the Muir Glacier of Alaska flows about 10 feet a day. Some of the Greenland glaciers are said to flow much faster. Glacier motion, however slow, is continuous. It is less in winter than in summer, and slightly less in frosty nights than in warm and rainy days.

Crevasses.— Though obedient to the laws of liquid motion in general, a glacier refuses to stretch, as is shown by its breaking sharply asunder at right angles to tension strains, thus forming the so-called transversal, longitudinal, marginal, and *bergschrund* crevasses. The first two are caused by unevenness of the channel, the marginal by differential motion, the *bergschrund* by the glacier flowing away from the motionless snow attached to the head of its basin. The last is of course a feature of all glaciers: so are the marginal crevasses, since the middle of all glaciers flows faster than the sides; but large central areas, where the bed is regular in slope or slightly concave, are free from crevasses. The largest crevasses are several miles long, 1,000 feet deep or more, and 30 or 40 feet wide, though at first they are usually too narrow to admit a knife-blade. In some places all sorts of crevasses are interlaced, forming labyrinths of yawning gulfs defying the skill and will of the bravest mountaineer who tries to hew a way through them.

Regelation.— The brittleness of ice, with its flowing motion, is partly explained by regelation. In 1850 Faraday discovered that when two pieces of thawing ice are placed together they freeze at the points of contact. Snow at a temperature of 32° F., stuffed into a mold and squeezed, becomes transparent ice. So also, fragments of ice pressed in a mold break, are crushed, and recongealed into a solid mass of the form of the mold, illustrating the breaking of glaciers and their regelation when from change of position the sides of the chasms, great or small, are pressed together.

Moraines.— The life of a glacier is one eternal grind. Its draining streams are always milky with rock mud rubbed off its bed, and separated from the large detached masses by the waters. Moraines, lateral, medial, and terminal, are the general detritus of a glacier and the weathered heights about it, drawn out and arranged by the ice currents, and located as their names indicate. The medial moraines, of which each glacier has one fewer than the number of its tributary glaciers, are formed by the union of two laterals at the confluence of the tributaries, and extend down the trunk in beautiful order. The terminal moraine is made up of parts of all the others. The moraine material, clay, sand, and boulders, of the great continental glaciers of the Ice Age, is often called drift. The detached rock masses, borne along by the ice currents and left in the terminal moraines, or if the glacier reaches the sea, dropped perhaps hundreds of miles away by icebergs, are called erratics.

The most striking features of large glaciers are the medial moraines, the lakes and streams on its surface, the wild ice cataracts corresponding to the cascades and rapids of rivers, and the discharging frontal wall, with its icebergs upheaving, sinking, and roaring amid eternal thunder. Glaciers vary widely in size and form; they may be classified as follows:

(*a*) Continental glaciers, of which only two now exist, the Greenland and South Polar ice caps.

(*b*) Glaciers of the first order, which are more or less river-like, flow into the sea, and terminate in berg-discharging ice cliffs.

(*c*) Glaciers of the second order, which approach the sea, but do not enter it, and of course do not discharge icebergs, waste from melting and evaporation equaling the snow supply.

(*d*) Glaciers of the third order, residual branches of those of the second, separated and made independent by the melting away of the trunks to which they belonged. Nearly all the glaciers of the world are now of this order.

Distribution of Glaciers.— Most of the glaciers of North America are distributed along the mountain ranges of the Pacific coast between lat. 36° 30′ and 36°. About 65 small residual glaciers a mile or less long still linger on the Sierra Nevada of California between lat. 36° 30′ and 38°, at an elevation of 11,000 to 12,000 feet above sea-level. Groups of larger glaciers drain the snow-fields of Mount Shasta and the high volcanic mountains of the Cascade Range in Oregon and Washington. From ice-crowned Mount Rainier, 14,600 feet high, eight glaciers, 5 to 10 miles long, descend into the forests to within 3,000 and 4,000 feet of sea-level. The

broad, lofty mountain chain extending along the coasts of British Columbia and southeastern Alaska is generally ice-laden; the upper branches of the main cañons are occupied by glaciers, which gradually increase in size and descend lower, up to the highest and snowiest region of Alaska between lat. 56° and 61°, where a considerable number flow into arms of the sea. This is the region of greatest glacial abundance on the continent. To the north of lat. 61° the glaciers gradually diminish in size to about lat. 62° 30′ or 63°. Beyond this, to the north end of the continent, few if any glaciers now exist, the ground being comparatively low and the snowfall light.

Glaciers of the third order, a mile or two to 15 or 20 miles long, fill the uppen cañons and hollows of the highest region in countless thousands.

The large glaciers of the second order number about 100. They are distributed along the coast from the mouth of the Stickeen River to Cook Inlet and the Alaska Peninsula, pouring their majestic floods from far-reaching fountains in the white recesses of the peaks. The expanded fan-shaped ends of many of this order are from two to four or five miles wide. The largest among these are the Malaspina Glacier, the Miles, Yakutat, Grand Plateau, Crillion, and La Pérouse, fronting the sea along the St. Elias and Fairweather mountains. The Malaspina is the largest of them all, being about 20 miles long and 65 or 70 miles wide,—a grand undulating ice prairie sloping gently from the base of the St. Elias Mountains, and separated from the sea by a girdle of forested moraines five or six miles wide, except at Icy Cape, where it presents bluffs of pure ice that are being undermined by the waves. The La Pérouse also presents ice bluffs to the open ocean, which at high tide are wave-washed, and small bergs are occasionally detached; but far the greater number terminate a mile or two from the tide line, back of moraines in rather low-spreading crevasse-gashed brows, over which one may easily climb.

The great glaciers of the first order flowing out into deep ocean water and discharging fleets of icebergs number about 31. One, the southmost, flows into the Le Conte Fiord in lat. 56° 50′, 4 into branches of Holkam Bay, 1 into Taku Fiord, 9 into the Glacier Bay fiords, 2 into Lituya Bay at the base of Mount Fairweather, 3 into Disenchantment Bay, and 11 into the wild fiords of Prince William Sound the northmost being a little above the 61st parallel,

The scenery of these fiords is of the grandest description. From wall to wall they are encumbered, often jambed with icebergs, which by the most active glaciers are discharged at intervals of a few minutes with thundering roaring that may be heard 5 or 10 miles away, proclaiming the restless work and power of these mighty crystal rivers, in striking contrast with the dead silence of those of the second order, though they also, except at their decaying ends, are ceaselessly flowing and grinding.

Glacier Bay is the iciest of the inlets which fringe the coast. Both to the north and south of it the glaciers are generally less lavishly snow-fed, and of course give birth to fewer icebergs. Of its nine glaciers of the first order, the Muir is the largest. It is about 50 miles long, the main trunk below the confluence of the principal tributaries is about 25 miles wide and probably about 1,500 feet deep. The berg-discharging part of the sea-wall is less than two miles wide, rises above the water to a height of 250 to 300 feet, and sinks to a depth of about 700 feet.

The grandest of the Prince William Sound glaciers are the Columbia, Barry, Harvard, Yale, and Harriman. Some of the smallest of the noble company descend flowery mountain-sides in the wildest and most imposing ice-cataracts.

Residual glaciers from a mile to 10 or 12 miles long, including neve, are distributed throughout the Rocky Mountain ranges from lat. 43° to 53°. The greater number lie between 50° and 52° 30′ at the heads of the Saskatchewan, Athabasca, and Columbia rivers. The largest groups are magnificent rags and patches of an ancient ice-sheet, some of them covering an area of 40 to nearly 100 square miles, and sending down river-like glaciers six to eight miles long.

Glaciers of the third order abound on the Alps, the Pyrenees, the Caucasus, the Scandinavian Peninsula, the Andes, the lofty snowy ranges of Asia, and on the mountains of New Zealand.

More than 1,000 with an area of about 1,200 square miles, have been surveyed and named in the Alps. The largest are river-like, 10 to 15 miles long, descend into the forests, and terminate at an elevation of 4,000 to 6,000 feet. Most of the smaller ones are like masses of pure snow, and terminate about 2,000 feet higher.

The Caucasus is perhaps about as heavily ice-laden as the Alps. Few of its glaciers are known to descend much lower than 6,000 and 7,000 feet. Those of the Pyrenees are comparatively small.

Many of the glaciers of Norway pour grandly down from extensive neve fields to within 1,000 feet of the sea-level. A few approach the shore and may rank as glaciers of the second order, while one, the only one in Europe of the first order, discharges into Jokul Fiord, near the 70th parallel. Between the larger glaciers flowing toward the heads of the fiords there are many hanging and cascading glaciers, ranged along the brows of plateaus, some of which pour over precipices in separate bergs with loud roaring like that of glaciers discharging into the sea. At the foot of the cliffs the battered fragments are welded, and thus these wild ice-streams, after their plunge through the air, are made whole again, and flow quietly on their way as "regenerated glaciers," the space between their upper and lower parts being only a wider kind of crevasse.

The low-descending New Zealand glaciers almost rival those of the Alps in size, while their beauty is greatly enhanced by the rich vegetation through which they flow.

The glaciers of South America are distributed along almost the whole extent of the Andes. According to Whymper those under the equator attain their greatest size on the snow-laden, storm-beaten summits of Antisana, Cayambe, and Chimborazo. On Cayambe, 12 glaciers of considerable size were counted, flowing from the central neve reservoir, descending to about 15,000 feet above sea-level. To the south of lat. 46° many approach the sea.

On the lofty mountain chains of Asia, especially the snowy Himalaya, Karakoram, Hindu-

1 Small Residual Glacier.

2. Front of Columbia Glacier

1. Hanging Glacier

2. Front of Muir Glacier.

Kush, Kuen-Lun, and Thian-Shan, thousands of little known residual glaciers still exist. The largest which have been explored are the magnificent Biafo and Baltoro Karakoram glaciers, 30 and 35 miles long, descending to about 11,500 and 12,000 feet.

Excepting Australia, which seems to have lost all its glaciers, Africa is glacially the poorest of the continents. Its only known glaciers are those of the two great snowy mountains, Kenia and Killimanjara, near the equator.

The Arctic islands — Jan Mayen, Nova Zembla, Spitzbergen, Franz-Joseph Land, and many others — are heavily ice-laden. Their largest glaciers are broad sheets discharging magnificent bergs into the frozen sea.

But it is on Greenland and the South Polar lands that glacier ice reaches its grandest development. Excepting a narrow interrupted strip around its shores, Greenland lies buried beneath a continuous mantle of ice thousands of feet in thickness, through which only the tops of its highest peaks, called "nunataks," protrude. From this ice-cap huge glaciers pour into the sea, discharging icebergs of enormous dimensions, some of which sail into the Atlantic thousands of miles from home.

Still greater is the South Polar ice-cap, probably over two miles in thickness. The sea front of some of the glacier currents it pours forth are from 100 to over 400 miles wide, from which flat-topped island-like icebergs 5 to 10 miles long are discharged. Here the great cosmical winter of the Glacial Period still exists in severe, serene grandeur.

Greater Extension of Glaciers.— That a great part of the earth in both the northern and southern hemispheres, now warm and fruitful, was recently covered by flowing, grinding ice, is well known. Over the eastern half of North America from the Arctic regions to lat. 40° or lower, moraines and beds of moraine material variously modified, grooved, scored, and polished surfaces, with other characteristic traces of glacial action, are displayed in wonderful abundance and uniformity.

Along the mountain ranges of the west side of the continent they extend still farther south. The broad Rocky Mountain chain and the plains along its flanks abound in glacial traces on a grand scale. On the Sierra Nevada polished and striated rock surfaces the most evanescent of glacier inscriptions may still be found as far south as lat. 36°; while a degree or two farther north, at an elevation of 7,000 to 8,000 feet above the sea, there are broad glacier pavements in so perfect a state of preservation that they reflect the sunbeams like glass and attract the attention of every observer.

Over the greater part of Oregon, Washington, British Columbia, and the Arctic and sub-Arctic regions about Bering Sea and northwestern Alaska, the rocks in general are less resisting, and the weathering they have been subjected to is more destructive. Therefore the superficial records of glaciation are less clear in these northern regions than in California.

But in all glaciated regions there are other monuments of ice action which endure for tens of thousands of years after the simpler traces we have been considering have vanished. These are the sculpture and configuration of the landscape in general,— the cañons, valleys, fiords, mountains, ridges, and *roches moutonnees*, the forms, trends, and correlations of which are specifically glacial and almost imperishable. These also, it is true, suffer incessant waste, being constantly written upon by other agents. But because they are so colossal in size and peculiar in form and arrangement they continue to stand out clear and telling through every after inscription, showing how great the ancient glaciers must have been, and how great are the geographical and topographical changes they have produced. On the Atlantic coast, where man is busiest, even in the parks and gardens of New York, glaciated rocks shine and call attention to the story of the Ice Period; and in orchards growing on moraine soil around the town of Victoria on the west side of the continent, fruitful boughs drop apples and peaches on the edges of glacier pavements, while the harbor rocks are still bright notwithstanding the centuries of wave-action they have been subject to. Thus strikingly are the works of ice displayed beside the works of man; yesterday in nature's chronology our continent now so fertile was a dreary wilderness of ice. No tale of fairyland is so exciting to the imagination as the story of the works and ways of snow-crystals banded together as glaciers and marching forth from their white tents on the highlands to develop earth's beauty, make beds of fertile food-soil, basins for lakes, valleys for rivers; to separate continents and sculpture their shores into countless islands, bays, sounds, and fringing fiords, then vanishing like clouds.

This change from icy darkness and death to life and light was slow as we count time, and is still going on wherever glaciers exist. The great winter of the Glacial Period is giving place to a great summer before which all the glaciers of the world are wasting away,— the Polar ice-caps, as well as the small shrinking remnants. All are shorter, narrower, shallower than they once were. The world is growing warmer, the snow-supply diminishing. But in trying to account for these changes we must bear in mind that the same sunshine that wastes glaciers nourishes them. In the formation of glaciers an enormous amount of sun heat is required to produce the vapor for the snow of which they are made. For the structure and physics of glaciers, see Agassiz, 'Système Glaciale'; J. D. Forbes, 'Travels in the Alps'; and 'Norway and Its Glaciers'; Tyndall, 'Glaciers of the Alps.'

JOHN MUIR,
Geologist, Explorer, and Naturalist.

Glad'den, Washington, American Congregational clergyman: b. Pottsgrove, Pa., 11 Feb 1836. He was graduated at Williams College in 1859; ordained in the Congregational Church, and after several other pastorates became pastor of the First Congregational Church in Columbus, Ohio, in 1882. He is widely known as a writer on social reforms. His publications include: 'Plain Thoughts on the Art of Living' (1868); 'Workingmen and Their Employers' (1876); 'The Christian League of Connecticut' (1883); 'Things New and Old' (1884); 'The Young Man and the Churches' (1885); 'Applied Christianity' (1887); 'Parish Problems' (1888); 'Burning Questions' (1889); 'Who Wrote the Bible' (1891); 'Tools and the Man' (1893); 'Social Facts and Forces' (1897); 'Art and Morality'

(1897); 'The Christian Pastor' (1898); 'How Much is Left of the Old Doctrine' (1899); etc.

Gladiators (Lat. «swordsmen»), combatants who fought at public games in Rome for the entertainment of the spectators. Gladiators were first exhibited at Rome in 264 B.C., by Marcus and Decimus Brutus at the funeral of their father; and the custom probably originated in Etruria, where a slave was killed at his master's pyre. Gladiators also fought at public festivals and other entertainments. They were at first prisoners, slaves, or condemned criminals; but afterward freemen fought in the arena, either for hire or from choice. Under the empire persons of senatorial rank, and even women, fought in the arena. The regular gladiators were instructed in schools («ludi») established for this purpose. The overseer of the school («lanista») purchased the gladiators, trained them and rented them to those who gave games to the people. Men of position, especially such as aimed at popularity, sometimes kept gladiatorial schools of their own, and hired lanistæ to instruct them. The gladiators fought in the schools with wooden swords. The games were commenced by a «prælusio,» in which the combatants fought with their weapons of wood till, upon a signal, they assumed their arms, and began in earnest to fight in pairs. In case the vanquished was not killed in the combat, his fate was decided by the people. If they decreed his death, the thumb was held up in the air; the waving of handkerchiefs was the signal to save him. In general they suffered death with wonderful firmness, and the vanquished often exposed himself to the death-blow. If he wished to appeal to the people he raised his hand. When a gladiator was killed attendants dragged his body away with iron hooks. The gladiators were often released from further service, and presented with wooden swords, as badges of freedom, from which they were called «rudiarii.» The gladiators were divided into classes, according to their mode of fighting: the «andabatæ» fought blindfold; the «catervarii» fought in troops; the «essedarii» fought in chariots, like the Gauls and Britons. Other classes were the «retiarii,» armed with net and trident but unprotected by any armor, their usual opponents being armed as Gauls, and styled «mirmillones.»

The most celebrated gladiatorial statues are: (1) The Gladiator Borghese, a combatant with extended arm in the act of warding off a blow. It is a statue of the first rank, made of fine grained marble, and is now in the capitol, to which it was restored from Paris 1815. (2) The Dying Gladiator, purchased from the Ludovisian collection for the Museum Capitolinum. It is a dying warrior, and not a gladiator, probably, to judge by his «torques» or twisted necklace, a Gaul, who is wounded and is trying to rise.

Gladiolus, glā-dī'ō-lŭs (Lat. «a small sword»), a genus of plants of the order *Iridaceæ;* sword-lily. It received its name from the shape of its leaves. It has bulbous rhizomes, and the stems are leafy and bear beautiful flowers which, in garden culture, open in midsummer. There are nearly 100 species, some of them natives of southern Europe, the greater number being found in South Africa. Gladiolus is largely cultivated in the United States, and Long Island, N. Y., has important fields of it.

Glad'stone, Herbert John, English politician: b. London 7 Jan. 1854. He was educated at Eton and Oxford. He was private secretary to his father 1880–1; under-secretary home office 1892–4; first commissioner of works 1894–5; and Secretary of State for Home Affairs 1905. He sat in Parliament for Leeds 1880–5, and for Leeds West from 1885.

Gladstone, John Hall, English scientist: b. London 1827; d. 6 Oct. 1902. He was Fullerian professor of chemistry at the Royal Institution 1874–7, and a member of the London School Board 1873–94. He published: 'Life of Michael Faraday' (1872); 'Spelling Reform from an Educational Point of View' (1878); 'Chemistry of Secondary Batteries' (1883).

Gladstone, William Ewart, English statesman, orator, and author: b. Liverpool 29 Dec. 1809; d. Hawarden, England, 19 May 1898. He was educated at Eton and at Christ Church, Oxford. He had distinguished himself greatly as a speaker in the Oxford Debating Society and soon became known as a young man of promise, who would be able to render good service to the Conservative party. He was invited to contest the Scottish burgh of Newark and was elected. He delivered his maiden speech and made a decided impression on the House of Commons. In December 1834 Sir Robert Peel appointed him to the office of a junior lord of the treasury. The great struggle on the question of the repeal of the Corn Laws was now going on. It is a somewhat curious fact that he was not in the House of Commons during the eventful session when the great battle of free trade was fought and won.

Up to the time of the abolition of the Corn Laws, or at least of the movement which led to their abolition, he had been a Tory of a rather old-fashioned school and in 1847 represented Oxford in Parliament. He startled Europe and indeed the whole civilized world in 1851, by the terrible and only too truthful description which he gave in 1851 of the condition of the prisons of Naples, under the king who was known by the nickname «Bomba,» and the cruelties which were inflicted on political prisoners in particular.

By the death of Sir Robert Peel in 1850 he had lost a trusted leader and a true friend. But it was not until after Peel's death that he compelled the House of Commons and the country to recognize in him a supreme master of parliamentary debate. The first really great speech made by him in Parliament was made in the debate on Mr. Disraeli's budget in the winter of 1852, the first session of the new Parliament.

On the fall of the short-lived Tory administration Lord Aberdeen came into office and formed the famous coalition ministry. Lord Palmerston took what most people would have thought the uncongenial office of home secretary; Lord John Russell became secretary of foreign affairs. Gladstone was chancellor of the exchequer. His speech on the introduction of his first budget was waited for with great expectation; but it distanced all expectation. A budget speech from Gladstone thereafter came to be expected with the same kind of keen artistic longing as waits the first performance of a new opera by some great composer.

The Crimean war broke up the coalition ministry. A motion by Roebuck for inquiry into the condition of the army before Sebastopol was carried by a large majority against the government. Lord Aberdeen at once resigned. Lord Palmerston was the one indispensable man, and he became prime minister. Gladstone gave the government of Lord Palmerston a general support, until, after the attempt of Orsini on the life of the Emperor Napoleon III. in 1858; Palmerston introduced his ill-fated Conspiracy to Murder Bill. The government was defeated, Lord Palmerston resigned, and Lord Derby was called on to form a new ministry.

The year 1859 saw Lord Palmerston back again in office and Gladstone as chancellor of the exchequer. The budget of 1860 was remarkable. Gladstone introduced a provision for the abolition of the duty on paper — a duty which was simply a tax on reading, a tax upon popular education and the next session the Lords passed measure for the repeal of the duty. The death of Lord Palmerston in 1865 called Lord Russell to the position of prime minister. Gladstone's mind had long been turning in the direction of an extension or rather expansion of the suffrage. The bill he proposed was defeated (1866), but when Disraeli came into office he introduced a reform bill of his own, which was practically a measure of household suffrage for cities and boroughs.

About this time the attention of Gladstone began to be attracted to Ireland. He made short work with the Irish State Church. He defeated the government on a series of resolutions foreshowing his policy; the government appealed to the country; the Liberals returned to power, and Gladstone became prime minister (1868). In his first session of government he disestablished and disendowed the state Church in Ireland. In the next session he passed a measure which recognized the right of the Irish tenant to the value of the improvements he had himself made. For the first time in English history a system of national education was established. The Ballot Act was passed for the protection of voters. The system of purchase in the army was abolished — by something, it must be owned, a little in the nature of a *coup d'état*. Then he introduced a measure to improve the condition of university education in Ireland. The bill was thrown out and he tendered his resignation of office. Disraeli came back to power, and Gladstone retired from the leadership of the House of Commons (1874).

For a while he occupied himself in literary and historical studies, and he published essays and pamphlets. But even in his literary studies he would appear to have always kept glancing at the House of Commons. The Parliament which had gone from the spring of 1874 was dissolved in the spring of 1880, and Gladstone, after the famous Midlothian campaign had become prime minister once more.

It was an unpropitious hour at which to return to office. There were troubles in Egypt; there was impending war in the Sudan, and in South Africa. There was something very like an agrarian revolution going on in Ireland; and the Home Rule party in the House of Commons was under new, resolute, and uncompromising leadership. It is to the credit of the Conservative party that after a while they co-operated cordially with Gladstone in his reforming of 1885.

The use he made of office and power astonished his enemies, and startled and alarmed not a few of his friends. His government had had in the years between 1881 and 1885 to fight a fierce battle against the policy of obstruction organized by Parnell, the leader of the Home Rule party. But when the elections under the new and extended Reform Bill were held, and the Irish Nationalist party came back 87 members out of the whole Irish representation of 103, in March 1886 he brought in a measure to give a statutory parliament to Ireland. In 1893 his Home Rule Bill was carried in the House of Commons, but was thrown out in the House of Lords. Owing to the increasing infirmities of age, especially impaired eyesight, the veteran statesman resigned 3 March 1894, and was succeeded by Lord Rosebery. He still took an interest in public affairs and busied himself with literary work. In January 1898 he published his reminiscences of Arthur Hallam; but falling seriously ill, after some months of suffering borne with noble fortitude, he died at Hawarden. He was buried in Westminster Abbey. Among Mr. Gladstone's works are: 'The State in its Relations with the Church' (1838); 'A Manual of Prayers from the Liturgy' (1845); 'Two Letters on the State Persecutions of the Neapolitan Government' (1851); 'Studies on Homer and the Homeric Age' (3 vols. 1858); 'A Chapter of Autobiography' (1868); 'Juventus Mundi' (1869); 'The Vatican Decrees, bearing on Civil Allegiance' (1874); 'Vaticanism' (1875); 'Homeric Synchronism Gleanings of Past Years' (7 vols. 1870); 'The Irish Question' (1886); 'A Translation of Horace' (1894); and 'The Psalter with a Concordance.'

Glagolitic (glag-ō-lĭt'ĭk) **Alphabet,** a Slavvonic alphabet classed as ancient Bulgarian. There is a MS. of the 11th century written in this alphabet in the Vatican, containing extracts of the Gospels for each day in the year; there are extant also three other MSS. written in the same letters.

The origin of this alphabet is undiscoverable. It is older than the Cyrillac; it may be a modification of Greek cursive writing; perhaps it is connected with Armenian and Albanian alphabets. Its use is confined to the liturgical books of Dalmatian Slavs. Cyril, a monk of Constantinople invented the Cyrillac alphabet, of which this has sometimes been considered a variant. Both of these differ from the current Russian alphabet.

Glagolitsa. See GLAGOLITIC ALPHABET.

Glair (Lat. *clarus*, clear, Fr. *glaire*), the white of eggs prepared and used as a varnish for preserving paintings. For this purpose it is beaten to an even consistence, and commonly mixed with alcohol to make it work more freely, and with a little fine sugar to give it body and prevent it cracking, and then spread over the picture with a soft brush. Bookbinders also use it for finishing the leathern backs of books.

Glaisher, glā'shėr, **James Whitbread,** English meteorologist: b. Lewisham, Kent, 7 April 1809; d. Croydon, Surrey, 7 Feb. 1903. In 1840 he became superintendent of the magnetical and meteorological department of the Royal Ob-

servatory, a post which he held for 34 years. Between 1862 and 1866 he made 28 balloon ascents for the purpose of studying the higher strata of the atmosphere, on one occasion reaching a height of over seven miles. He was the founder of the Royal Meteorological Society, became a Fellow of the Royal Society in 1849, and wrote numerous papers on subjects relating to astronomy and meteorology.

Glance, English equivalent of the German *glanz*, a term applied to opaque minerals of which the high lustre and color indicate their metalliferous character. The following are some of them: *Antimonial copper-glance*, or wölchite, sulphide or antimony, copper, and lead, with a little iron; *antimony-glance*, or stibnite, sulphide of antimony; *bismuth-glance*, or bismuthinite, sulphide of bismuth; *cobalt-glance*, or cobaltite, sulph-arsenide of cobalt sometimes with a little iron, also nickel and antimony; *copper-glance*, sulphide of copper; *glance-blende*, or manganese blende, sulphide of manganese; *glance-coal*, anthracite; *iron-glance*, or specular iron, oxide of iron; *lead-glance*, sulphide of lead or galena; *nickel-glance*, amoibite or gersdorffite, arsenide and sulphide of nickel, with cobalt, iron, etc.; *silver-glance*, sulphide of silver; *yellow-gold-glance*, or sylvanite, telluride of gold and silver; *zinc-glance*, silicate of zinc. German miners use almost indifferently the term *glanz* and *kies*, the latter signifying pyrites, as iron pyrites, copper pyrites; but glance is not so frequently used among American and English miners, though copper-glance, antimony-glance, are sometimes employed by scientific men as well as in the mines.

Glan'ders, the most dangerous form of equinia, and one of the most formidable diseases to which horses are subject. It is diagnosed by a discharge from one or both nostrils, with a hard enlargement of the submaxillary glands. It is distinguished into acute and chronic. In acute glanders the discharge from both nostrils is so great as ultimately to impede respiration and produce death from suffocation. Chronic glanders may run on for years before it terminates in the acute form of the disease. The discharge is usually confined to one nostril, is only occasional and sometimes trivial, with a moderate swelling of the gland on the affected side. The only other symptom of disease is a harshness of the coat. In the latter stages the discharge becomes offensive. The disease is highly infectious, and acute glanders may be communicated to healthy horses and asses, while the animal first affected is still able to feed and work apparently as well as ever. It may even be communicated to man by the pustular matter coming in contact with any part where the skin is broken; and not a few deaths have happened through this cause. The disease is often difficult to determine, as the discharge is only offensive in the latter stages. The symptoms may be mitigated by tonics and other treatment, but it is rarely if ever cured. The disease is now known to be produced by a species of bacillus about the size of the tubercle-bacillus. See FARCY.

Glandina, glăn-dī'na, a genus of large spirally elongated snails (q.v.), which attain their maximum development in the southern United States and in Mexico. They include many species, all graceful in outline and beautifully colored. A rosy species (*Glandina truncata*) is common along the coast of Florida and westward, which varies greatly in size according to its circumstances, in favorable localities reaching a length of four inches. These mollusks are most commonly found among the marsh-grasses, where they hunt for and devour other snails by filing through their shells and rasping away the flesh by means of their lingual ribbons. Marine mollusks and other animals are also attacked.

Glasgow, Ky., a city and county-seat of Barren County, 100 miles south of Louisville, on the Louisville & N. R.R. It is situated near the oil well district, and has manufactures of plows, wagons, tobacco, sashes, and blinds. There are several public schools, 3 banks, and weekly newspapers. The Liberty Female College is located there. Pop. (1900) 2,019.

Glasgow, Scotland, the second largest city in the United Kingdom, situated in the counties of Lanark and Renfrew, on both banks of the Clyde. Much the largest and most populous portion of the city is in Lanarkshire, and of this portion again the greater and more important part is on the right bank of the Clyde. Glasgow now forms a county of a city as well as a municipality, and the boundaries were recently extended; but the contiguous police burghs of Partick, Govan, Kinning, Park, and Pollokshaws, with other populous areas, are as yet outside its limits. The north and south sides of the river are connected by bridges and ferries, the latter at convenient intervals. The bridges are: the Caledonian Railway bridge, leading into and out of the Central Station; Glasgow or Broomielaw bridge, in line with Jamaica Street, a stone bridge 80 feet broad, recently rebuilt and widened, the features and materials of Telford's earlier structure (1835) being retained; Portland Street Suspension bridge; Victoria bridge (stone), Stockwell Street; the Union Railway bridge (stone and iron), used by the Glasgow and Southwestern Railway Company; the Albert bridge (stone and iron), close to Glasgow's oldest park, called The Green; Rutherglen bridge; and Dalmarnock bridge. Tunnels under the river have also been formed for cross-river traffic, and a cable subway running in a circular course twice passes from side to side in this way. There are underground and various other local railroads owned by the corporation, and small harbor steamers for passengers.

Glasgow is built mostly of a light-colored sandstone quarried in the neighborhood, but a red sandstone brought from a distance is now being freely employed. The streets are in general wide and straight, running mostly at right angles. Glasgow as a whole is excelled by few cities in the kingdom in architectural beauty and general amenity of appearance. It possesses few squares worth mention, the chief being George Square, in the heart of the city. On the other hand, it has now a series of fine parks and recreation grounds. The chief are: the Green (140 acres), with a People's Palace and winter gardens; Kelvingrove Park, intersected by the Kelvin; the Queen's Park; Bellahouston Park (178 acres); and Alexandra Park. The

city also possesses botanic gardens, with extensive ranges of hothouses and greenhouses.

Pre-eminent among edifices stands the Cathedral, Glasgow's only ancient building, on the edge of a ravine separating it from the Necropolis (the chief public cemetery). It is a large Gothic edifice in the early pointed style, with tower and spire rising from the centre, but without transepts; length of interior, 319 feet; width, 63 feet; height of nave, 90 feet; of choir, 85 feet; spire, 225 feet. It is especially distinguished for the beauty of its crypt, which is one of the most beautiful in Great Britain. The cathedral as it at present stands is supposed to have been begun before 1197, and completed within the 15th century. The chancel is used as a parish church, and the structure is under the charge of the government. Many of the other churches are marked by a high degree of architectural merit. Among other buildings are those of the university opened in 1870, and covering about four acres of ground, on Gilmorehill, a magnificent site overlooking the Kelvingrove Park. The main building is an oblong rectangular pile in the Collegiate Gothic style of the 14th century, about 600 feet long by 300 broad, divided into two quadrangles of 180 feet square, united by a centre building, and having a tower and open-work spire about 300 feet high. Another edifice of similar importance is the municipal building or city chambers, accommodating various departments connected with the corporation. This is an imposing structure in the Italian or Renaissance style, occupying a large area, and filling up the whole side of George Square. Other buildings abutting on the same square are the Bank of Scotland, and Merchants' House. Among other buildings are: The United Free Church College, a building in the Italian style with a high tower; the Royal Exchange, in the Corinthian style surmounted by a circular clock tower; the Stock Exchange, in the Venetian Gothic style; the Athenæum buildings, the Deaf and Dumb Institution, the Christian Institute, the Royal, the Western, and the Victoria infirmaries, the St. Enoch Station and Central Station hotels, the buildings of Glasgow and West of Scotland Technical College, the Procurators' Hall, etc. In George Square are statues of Queen Victoria, Prince Albert, James Watt, Lord Clyde, Robert Burns, Dr. Livingstone, Sir John Moore, etc., and a tall fluted Doric column surmounted by a statue of Sir Walter Scott. Elsewhere there are also equestrian statues of King William III. and of Wellington, besides an obelisk to Nelson in Glasgow Green, etc.

The educational institutions after the Glasgow University (q.v.) are St. Mungo's College; Anderson's College Medical School (founded 1796); the United Free Church College (for divinity students); the Glasgow and West of Scotland Technical College; Queen Margaret College for women, connected with the university; the Glasgow Academy and the Kelvinside Academy; the normal institutions of the Established Church and United Free Church; Allan Glen's School connected with the Technical College; the Glasgow School of Art; School of Music in connection with the Athenæum; and the Veterinary College.

The principal libraries are the University Library (175,000 vols.), the Mitchell Free Library (about 140,000 vols.), the libraries of the Faculty of Physicians and Surgeons and of the Faculty of Procurators, the combined Glasgow and Stirling's Libraries (45,000 vols.), and Baillie's Library. The Public Libraries Acts are to be adopted, and Andrew Carnegie has given $500,000 for the establishment of district libraries.

The town council consists of 75 councilors, elected by 25 wards, and of the dean of Guild (elected by the Merchants' House) and the deacon-convener of the trades (elected by the Trades' House), as ex officio members. The lord-provost, 14 bailies, and a river bailie and deputy bailie are chosen from among the councilors. The river and harbor are under the management of the Clyde navigation trustees.

The manufacturing industries of Glasgow, including also those of the surrounding and dependent districts, are unequaled for variety by any manufacturing town in the kingdom, with the exception, perhaps, of London. Among the older industries of importance are those connected with cotton, linen, and wool, including spinning and weaving, dyeing and bleaching, calico printing, and Turkey-red dyeing in particular. But the Glasgow of to-day is most largely dependent on iron and coal, and the importance of its textile industries is relatively less than formerly. It is the leading market for the whole iron production of Scotland, and there are blast furnaces and collieries within the city boundaries. The most important industry is ship-building and the connected trades, the Clyde, which was the birthplace of steam navigation in Europe, having ever since been closely associated with the growth and development of steam ship-building and marine engineering. Some 300,000 tons of shipping are usually built yearly. The commerce of Glasgow is commensurate in extent with the importance of its manufactures, and is closely associated with these. The value of foreign and colonial produce imported in 1900 amounted to $70,000,000; that of the home produce exported was $92,000,000. Large imports of tea, cotton, and other produce are received coastwise from London and Liverpool. The rental of Glasgow in 1900 was $27,000,000.

All the leading banks of Scotland are represented in Glasgow by numerous branches, and the Union Bank of Scotland and the Clydesdale Bank have their head offices here, as also have some insurance companies. The principal railway systems are the Caledonian, North British, and Glasgow and Southwestern, all of which have large modern termini in the heart of the city. There are underground railways, and the cable subway already mentioned, which twice passes under the river. The Forth and Clyde and Monkland canals form auxiliary means of communication.

Glasgow has long been distinguished for the energy and public spirit of its local government. The trade and commerce of the city, its amenity, and its sanitary condition have all profited in turn by liberally conceived measures, successive provosts having vied in associating their reign with important schemes of improvement. The improvement of the navigation of the Clyde was the first and greatest of these schemes of local improvement. The gas works belong to the corporation, and the gas is supplied at a low rate. The streets are now partially lighted

by electricity, and the corporation has erected great power houses.

Beyond its own commercial growth Glasgow has contributed little to general history. Although the most important city of Scotland, it has never been the capital of a county. Its local history is, however, peculiarly rich in characteristic incidents. Ancient Glasgow was situated on the high ground immediately around the cathedral, from which it first extended down to the river, and afterward spread in all directions. The city was for many centuries purely ecclesiastical. Its nucleus has been traced back as far as the origin of the bishopric founded by St. Mungo about 560. The convents of the Gray and the Black Friars had elegant churches attached to them, one of which at least is supposed to have been earlier than the cathedral. Rottenrow, Castle, Drygate, Kirk, High, Saltmarket, Gallowgate, Bridgegate, and Trongate streets are known to have been in possession of the public as early as 1100. The bishopric was refounded by David, Prince of Cumberland, in 1115. John Achius, his tutor, who was appointed bishop, is said to have begun the cathedral. In 1176 weekly markets and annual fairs were instituted by the prior of Grayfriars. The city was erected into a royal burgh in 1180. Provost and bailies are mentioned in a charter dated 1268.

The corporation of fishers was probably the earliest trade incorporation. The first Stockwell street bridge was built by Bishop Rea in 1345. In 1350 St. Ninian's Hospital for lepers was founded. In 1393 a mint was erected in Drygate Street. The tower of the cathedral was commenced by Bishop Lauder in 1408. In 1546 the shipping of Glasgow is mentioned in an order of the privy council. Some persecutions occurred in Glasgow during the period of the Reformation. The Confession of Faith was signed by 2,250 persons in 1581. From this time till about the time of Cromwell's visit in 1650 the most powerful governing body in Glasgow appears to have been the session, which issued its orders on all manner of subjects with a refreshing ignorance and contempt of law. The General Assembly which abolished episcopacy met in Glasgow Cathedral in 1638. Two great fires devastated the city, in 1652 and 1657. In 1748 the first delft works were erected, and in this works in 1763 Watt set up the model of a steam-engine. The steam-engine was introduced in a cotton-mill in Glasgow in 1792. The power loom being now introduced, the city soon became an important centre of the cotton manufacture. In 1816 the first vessel was despatched to the East Indies. Since then the trade has extended all over the world, the improvement of the river keeping pace with this extension. The cotton manufacture reached its highest point about 1860, and since then has both actually and relatively declined, but ship-building, engineering, etc., have more than made up for this. In 1888 a highly successful exhibition was held, and in 1901 a still larger was opened. The progress of Glasgow will be seen from the following figures of population: (1610) 7,644; (1660) 14,678; (1708) 12,766; (1740) 17,034; (1763) 28,300; (1785) 45,889; (1801) 77,385; (1811) 100,749; (1841) 255,650; (1871) 477,732; (1881) 511,415; (1891) 565,714; (1901) 760,423.

Glasgow, The University of, a corporate body founded by a bull of Pope Nicholas V., dated 7 Jan. 1450–1, as a "*studium generale tam in theologia et in jure canonum et civili quam in artibus et in quacunque licita facultate*," with the power of creating masters and doctors, who, together with the readers and students, were to enjoy the same privileges and immunities with the University of Bologna. A body of statutes was prepared, and the university established by the bishop and chapter in the same year. The university appears at first to have had neither property nor endowment. A purse was formed of the perquisites procured from matriculations, examinations, degrees, etc., and some of the earlier members bequeathed the patronage of a few small chaplaincies; but through the zeal of its founders and the civil and ecclesiastical immunities accorded to it, the new school of learning prospered, though in circumstances so little in accordance with modern notions of educational requirements. The clergy were induced to attend by offers of exemption from taxation and residence. The lectures in theology and in canon and civil law were read at the convent of the Dominicans; but the students of arts soon became so numerous that a house was provided for their residence called the pædagogium, and regular teachers were appointed.

In 1460 James, Lord Hamilton, bequeathed to Duncan Bunch, regent of the College of Arts, and his successors, a tenement in High Street, with four acres of land adjoining, for the use of said college. On this ground the classes of the university continued to meet for 410 years. In 1577 James VI. prescribed rules for the government of the university, and made a considerable addition to its funds. This new charter is called the Nova Erectio. It provided for a principal to teach theology and Holy Scriptures, who was also professor of Hebrew and Syriac; and three regents, of whom one taught Greek and rhetoric; another dialectics, morals and politics, with arithmetic and geometry; the third, physiology, geography, chronology, and astrology. Between this period and the Restoration the university continued to flourish, and the number of its professors increased; but at the Restoration the reestablishment of the Episcopacy deprived it of a great part of its revenues, and three of its chairs fell into abeyance. After the Revolution it continued gradually to expand the scope of its teaching, and has numbered among its professors and graduates many distinguished men. In the end of the 18th century it obtained by bequest the valuable anatomical museum, library, and other collections of the famous Dr. William Hunter. Later the old buildings became quite inadequate, and were sold. A grant for new buildings was procured from the government, a small sum was available from college funds, and public subscriptions were procured. In 1870 new buildings at Gilmorehill, which cost over $2,000,000, were erected.

The University of Glasgow comprises five faculties, namely, arts, science, medicine, law, and theology, the faculty of science having been recently added. The oldest chairs are those of moral philosophy (1577), natural philosophy (1577), logic and rhetoric (1577), Greek (1581), divinity (1630), Latin (previous to 1637), mathematics (revived 1691). In the first 20 years of the 18th century six professorships were either originally founded or revived,

namely, Latin, Oriental languages, civil law, medicine, church history, anatomy; astronomy was added in 1760. The remaining 18 professorships were founded in the 19th century. The university was reconstituted by the Scottish University Act, 1858, and a similar revolution was effected under the act of 1889.

The students number about 2,000. There are numerous bursaries connected with the university, the annual total value of which is about $40,000. There are also medals and prizes given in connection with the various classes, and scholarships or exhibitions are awarded to students who prove successful in certain examinations. The Snell exhibitions, established in 1677, send 10 (or fewer) Glasgow students to Oxford. They are tenable for five years, and each exhibition yields $400 per annum. The two Eglinton fellowships, founded in 1862, tenable for three years, and each worth $500 annually, are awarded by competition to students who have just graduated in arts. Three Ewing fellowships, of the value of $400 per annum, and tenable for not more than five years, are also awarded by competition among graduates in arts. The Luke fellowship, about $400 per annum, tenable for three years, is awarded to graduates for excellence in English literature and history. The George A. Clark scholarships, four in number, are tenable for four years, their annual value being about $900. The examinations are respectively in classical literature, mental philosophy, mathematics, and natural science. The Metcalfe fellowship, founded 1870, annual value $500, tenable for three years, is designed to encourage studies in higher mathematics, practical astronomy, civil engineering, and chemistry. There is also the Black theological fellowship, worth $700 annually.

Glass, a hard, brittle, transparent substance, formed by fusing together mixtures of the silicates of potash, soda, lime, magnesia, alumina, and lead in various proportions, according to the quality or kind of glass required.

Flint glass is used in making table-ware and many articles of domestic furniture and fittings. The molten glass is taken from the pot by a ponty, and is blown or pressed into shape, or, by a combination of operations, is held in a mold while being blown.

Crown glass is taken by the ponty from the pot, and is then blown and whirled until it becomes globular. A ponty tipped with molten glass is applied to the bulb, the blowing tube is detached, leaving a hole. The globe being again whirled, the glass flashes into a circular disk, adhering by a boss in its centre to the ponty. Crown and flint glass are combined in the manufacture of achromatic lenses.

Sheet glass is glass withdrawn by the ponty from the pot and blown and whirled till it assumes a cylindrical form. The ends beings cut off, and the cylinder slit longitudinally, the sheet is heated, pressed, and rubbed until it is flattened out. This is also called cylinder glass or broad glass.

Plate glass is made by pouring it upon a table which has a marginal edge of a height equal to that designed for the thickness of the glass. A roller travels over the table, on the ledges and flattening out the glass, which is thus made of equal thickness throughout.

Toughened glass is made by heating till it is about to soften, and then plunging it into a bath of oil at a greatly lower temperature. Usually a mixture chiefly of oily substances, such as oils, tallow, wax, resin, and the like, is put in the bath; and some manufacturers who worked the process, for a time dropped the newly made glass vessels, while still hot, into the oleaginous mixture, by which plan neither reheating nor annealing by the ordinary process is required. After the articles acquire the temperature of the bath, they are removed.

Painted or *stained glass* is of two styles, enamel and mosaic glass. In enamel glass proper, certain fusible pigments are painted on a sheet of white glass, which is then fired and the result is a picture the tints of which even in the high lights are not wholly transparent. A modification of this method produces its picture partly by enameling on white glass, partly by the use of pot-metal glass the color of which is heightened or modified by the use of enamels.

Of the origin of glass manufacture we cannot speak with certainty. Pliny states that the ancient Phœnicians discovered by a happy accident how to make it. He relates that certain Phœnician merchants preparing a meal upon the sea-shore set their cooking vessel on a mass of natron (sub-carbonate of soda) and the union of the sand and alkali, when subjected to the fire, resulted in vitrification that drew the men's attention and led to subsequent efforts at imitation. According to Egyptologists the Egyptians made sham jewels of glass at least 5000 or 6000 B.C. In some of the most ancient tombs scarabs of glass have been found imitating rubies, emeralds, sapphires, and other precious stones, and the glass beads found broadcast in three parts of the globe were quite possibly passed off by traders on confiding barbarians as jewels of great price. As a medium of trade, beads are evidently of great antiquity. Those known as aggry have been attributed to both Egyptian and Phœnician sources. The beads vary greatly in color and pattern and some of them show fine workmanship and marked beauty. During the period when Egypt was part of the Roman empire much glass was produced in the Nile valley.

It is probable that the great centre of glass industry of mediæval and more recent times, Venice, received its early impulse and lessons from Constantinople. The art began there with the beginning of the city in the 7th century A.D. and there was a marked improvement after the conquest of Constantinople in 1204, and in 1291 the establishments were removed to the island of Murano, the manufacturers forming a guild with a register of nobility, and guarding their secret with the greatest jealousy. In 1436 their color glass came into note, and continued so till the close of the century; and in the 16th century lace patterns and mirrors were introduced. In the 15th and 16th centuries plain glass with tasteful ornaments in gilt and enamel; in the 16th, cracked lace and reticulated glass, and in the 17th century variegated or marbled glasses were produced.

The Venetian glass enjoyed for a long time the monopoly of commerce, and within recent years there has been a marked revival of the skill and enterprise of Venetian craftsmen. In Germany the oldest glass dates from the [illegible] century, and consists of goblets and tankards of white color, enameled with colored coats of

arms and other devices, millefiori, and schmeltz glass. Engraved glass was first introduced by Casper Lehman at Prague in 1609 under imperial protection, and continued by his pupil Schwanhard; and ruby glass by Kunckel in 1679. In 1665 20 Venetian glass workers were brought by Colbert to Paris, where they set up the blowing of glass and the silvering of mirrors, the famous mirror hall in Versailles having been furnished by them. In 1688 an exclusive privilege of making large plates of glass by casting was conferred on Abraham Thevart. The name Thevart was assumed by a syndicate of capitalists formed to develop and work the invention of Louis Lucas de Nehon, who was the real inventor of plate glass and the founder of the Gobain works, one of the most extensive plate glass works in the world. In France oxide of lead flint glass was made at St. Cloud in 1784; another manufactory was subsequently established at St. Louis in 1790; and the St. Cloud establishment was removed to the vicinity of Mont Cenis, where it flourished till 1827.

It is uncertain whether glass was made in England before the 16th century, as that mentioned may have been imported from Flanders or Venice. In 644 Benedict Biscop introduced makers of glass windows into Northumbria; but window glass was not in general use for windows till the 15th century. Pressed glass was invented in the United States. See GLASS BLOWING; GLASS; CUT; GLASS MANUFACTURES IN AMERICA; GLASS STAINING.

GEORGE W. HASTINGS.

Glass Blowing, a mode of manufacturing various articles by taking a mass of viscid glass from the melting pot on the end of the blowing tube, and then inflating the mass by blowing through the tube, rolling on the marver, and exposing it at the furnace opening where its contained air is expanded and itself enlarged.

Although the forms into which blown glass is worked up are endless, the general methods of manufacture are the same, and a description of first-class lamp chimney works is illustrative of the blown glass industry in general. Perhaps the most important feature in the manufacture of lamp chimneys, or indeed of any form of glass-ware, is the mixing of the ingredients. As in the case of plate glass, the body of the mixture consists of a sand which is as nearly pure silica as can be obtained. The sand is quarried from silica rock, then thoroughly ground and sifted through a 40-mesh screen, the material being received at the works in the prepared condition. The second most important ingredient is litharge; while potash and soda are used as fluxes. When the above mixture is used for the best quality of lamp chimneys, about 50 per cent of the total is silica. The sand is melted in what is known as the furnace, the first and greatest of the glass blower's implements; it consists of two large domes set one above the other; the lower one stands over a large perforated grating (level with the ground), and is fired by gas, a large arch beneath conveying air to the furnace. In the sides of the lower dome as many recesses or mouths are made as there are workmen to make use of the furnace, and before each mouth a pot of glass mixture is placed; the pots are very large, like crucibles, and are molded from a specially prepared and very carefully kneaded pot clay; they stand 50 inches high and are generally 44 inches in their largest diameter, and will hold from three to four hundredweight of liquid glass; they are supported upon three small piers of brickwork resting on the floor of the furnace. The form of the furnace reverberates the flame from the roof down upon the pots, and they are placed at some distance within the furnace so that the flame may get between the wall and the pots. It takes about 24 hours to melt the contents of a pot.

The upper dome is used for annealing the glass, and is exactly similar to a large oven; it has three mouths, and a small flight of steps leads up to each. It is built upon the lower dome, its floor being made flat by filling up round the roof of the lower dome with brickwork; a small chimney opens from the top of the lower dome into the middle of the floor of the upper one, which conveys the fumes and smoke from it, and a flue from the upper dome leads it completely from the furnace.

The blowing is done with a long iron tube known as the blowpipe, which has a mouthpiece at one end, and is swelled out and thickened into a bell-mouth form at the lower end. In the process of blowing, the operator dips the thickened end into the melting pot and twists it around till he has gathered up a ball of molten glass of the desired size. The blowpipe is then withdrawn from the furnace and the ball of glass is rolled out to a conical shape on a plate and slightly inflated by blowing through the tube. The blowpipe is then handed to the second operator, who completes the operation of blowing. The bubble, if we may so call it, of glass is thicker and heavier at its lower end, and to secure the elongated form necessary in lamp chimneys the operator swings the blowpipe to and fro, thus causing the bubble to stretch by its own weight. By thus alternately swinging and blowing he brings the bubble to the required length, and approximately to the required diameter, and then places it within a hinged mold, which is opened to receive it, either by himself or one of his assistants. He then twists the pipe and blows at the same time, thus pressing the glass against the inner walls of the mold. The tube with the molded chimney attached is then withdrawn from the mold, and handed to another operator, who, with a pair of spring tongs, forms the flaring top of the lamp chimney and marks a sharp depression just outside its base, where it is to be broken away from the blowpipe. Although a large amount of blowing is done by hand and mouth, increasing use is being made of what is known as the Owens blowing machine, which substitutes mechanical for hand power. See GLASS; GLASS MANUFACTURES IN AMERICA.

Glass Crab, an immature condition of certain crabs (*Palinurus* and its allies) which for a time are flattened and perfectly transparent, as if formed of a sheet of glass, and have no resemblance to the parent form.

Glass, Cut or Incised. Glass is a singularly versatile material, at once refractory and yielding, yet lending itself to use in thousands of ways. It is as a means of artistic expression that it is chiefly interesting, for its utility is beyond all question. The iridescent chatoyant colors of antique glass — Nature's destructive action — do not distract us from the charm of perfect

form. Venetian glass, the beautiful product of the lagoon-island of Murano, is so very impracticably fragile that even its possession is a care. Probably glass would have remained in a rather humble position if it had not been that a Bohemian glass-worker more than 200 years ago conceived the idea of a new invention, which was destined to change the glass product of the world. He thought of making the heavy "flint" or "lead" glass larger as regards the dimensions of the walls of the article, in order that he might have more stock to work on, so that he could deeply incise or cut the glass to form patterns, the sides of the rough cut being in turn polished to give the effect of a many-faceted jewel. The success of the new *objet d'art* was not immediate, and it was only when the crude designs and imperfect workmanship of the earlier cutters gave way to the labors of highly skilled artisans directed by talented designers that cut glass, or "art glass," as we might term it, took the place to which its great beauty entitles it. It is to America that we must look for the perfection and the superiority of design and skilful workmanship of this branch of the industry. There is no such thing as absolute interchangeability in the glass-cutting establishment, and the artistic bent of the various cutters is encouraged.

The peculiar product known as glass has as a base silica, which is fused with alkalies and metallic oxides to form a hard transparent substance. It can be wrought in various ways, and is susceptible of a high, and, when properly cut, a lasting finish. The raw materials consist of a sand, so called, of exceptional quality as regards sharpness and color. It is not a sand in the ordinary sense of the word, but is a quarried rock which has been crushed. This accounts for the uniformity of its color, which is so necessary in producing a steely-blue white glass, which is to be used for giving the prismatic colors caused by the cutting process. The red lead, saltpeter, and sodium carbonate are accurately mixed with the sand, and a small percentage of white arsenic or manganese is added to bleach or clarify it. The proportion is varied according to the nature of the finished product. A glass furnace is a large round or oval fire-brick oven, capable of holding an aggregation of melting pots, which rest under a floor in common under a dome called a crown. These pots are made of unbaked fire-clay. A mouth gives entrance for the raw material and the workmen's blowpipes, to which the molten glass adheres. A furnace may contain as many as sixteen pots arranged radially on the floor of the furnace. They are heated before setting, and are subsequently filled with about 1,600 pounds of raw material, which soon melts at a temperature of 2,500° F., caused by the intense flame of gas and air, which is deflected from the dome downward, the products of combustion passing out through a stack.

The glass gatherer receives his order for a specified size and shape for his article: and after obtaining a sample to guide his memory, takes his iron blowing tube, and collecting sufficient of the molten glass from the pot in the furnace, rolls it to and fro on a metal plate to produce a uniformity of distribution of the mass, which is then reheated in a furnace called a "glory-hole." He then turns it over to a glass blower, who takes the pipe and blows the article to approximately its final shape. It is then reheated and given definite form and finish by the most expert workman of all three. The tender glass must now be annealed or tempered to equalize the strains, otherwise the piece would break. It is then placed in kilns or tempering ovens, where it is first reheated and then gradually cooled.

The heavy uncut articles are then ready for the cutting operation, by which they lose considerable weight. In some cases the loss is one-third. The cutting operation really consists of three stages. The article is first roughed with sand and a steel grinding wheel. It is then smoothed by a stone cutting wheel, and is lastly finished by a wooden polishing wheel. A workman holds the article against the conical edge of a steel wheel secured to a shaft driven by belts and pulleys. Fine sharp clean sand and water are allowed to drip on the wheel from a cone-shaped bucket. The article is pressed against the rapidly rotating wheel, and is deeply scored or cut. The heaviest and principal lines in the pattern are roughed-in by these steel wheels and the sand. In order that all articles may stand level, the bottoms are ground on a horizontal grinding wheel, sand and water still being used. The rough article is now ready for the wet smoothing stones, which resemble steel wheels both as to size and edge, but no sand is used: these wheels follow the cuts that the steel wheels have made, and also cut in the finer lines of the pattern. The practically finished piece is now ready for the polisher, whose rouge-charged wheels are of wood, their size and edge being the same as those of the steel and stone wheels, and therefore adapted to follow every line with almost mathematical accuracy, which completes the process. While cut glass is made abroad, the examples lack shape and depth and uniformity of cut. For this reason the foreign trade in American cut glass is increasing every year.

Glass, Malleable. American glassmakers, since the beginning of the industry, have aimed to produce a glass that would have all the clearness and beauty of ordinary glass, and at the same time possess a toughness which would render it as little liable to fracture as many of the other manufactured articles of use and beauty. It is well known that the ancients discovered and made use of a process of manufacturing malleable glass; and in the glass-making world it has naturally been expected that it would be in the Old World that the process would sooner or later be reinvented. Louis Kauffeld, of Matthews, Ind., succeeded in 1903, after many years of endeavor, in producing a glass which will withstand extremely rough usage without breaking. The secret lies principally in the chemicals which are used and the proportion of ingredients which form the compound, although the furnaces and crucibles play an important part in the process.

The two chief things to be avoided in connection with the crucible are intense and prolonged heat from without and the corrosion of the raw materials within — two dangers of which nearly every glass-maker knows the ruinous effect. The effect of corrosion is readily proved by heating for a long time in a small crucible such substances as borax, red lead, or potassic or sodic carbonate. After a crucible has been in constant use for several months, and especially if it has contained flint or lead glass, the back and body will be found to be

covered with innumerable small dents, which have undoubtedly been formed by corrosion.

The complaint so commonly heard of specky glass arises from the presence in the glass of white particles of an infusible aluminate formed by the combination of the alkaline or metallic ingredients of the glass with the alumina of the crucible. If the corrosion becomes concentrated at one point and prolonged for a considerable period a breach is formed, through which the molten glass escapes into the furnace. Knowing the dangers that have to be encountered in this way. Mr. Kauffeld is extremely careful in the selection and preparation of the clay as well as in the construction of the crucibles. The finely sifted raw clay, on its arrival at his manufactory, is mixed with a proportion of burnt clay considerably coarser in grain, varying in amount from one ninth to one fifth of its weight. The coarser particles tend to bind the clay and render the finished crucible less liable to crack from variation of temperature. Various tests have been made of Kauffeld's methods. For instance, a chimney was placed in a pail of ice-water, and after having remained a sufficient length of time to become as cold as the water, was taken out and immediately placed on a lamp with the blaze turned as high as possible. The blaze on the wick was turned so as to flow directly on the chimney, and the smoke which collected on the chimney ran down with the water without injuring the chimney. Next a chimney was placed over a small gas stove containing clay bricks used in heating such stoves. The fire was turned on full, the chimney remaining on the bricks. The fire finally brought the temperature to such a stage that one side of the chimney was drawn in and dropped down, and no crack was shown in the glass; but for a slight roughness on the outside, the glass was as clear as when placed in the fire.

Another test which was made was to place cold water in the chimney and hold the same over a fire until the water boiled. A large bulb was blown from the glass and filled with about one pint of water. It was then placed over the fire and allowed to remain there until it had boiled dry without apparent effect on the glass. Four chimneys were taken from the packing room and dropped one by one into a pail of boiling water. The chimneys were then hastily shifted into a pail of cold water that had just been drawn from a well, and the glass was not broken.

Glass Manufactures in America, a great industry that began in America near Jamestown, Va., in 1608. The hope of sudden wealth from the discovery of gold and silver was doubtless the chief cause for the formation of the London Company and its first attempt to colonize Virginia. It was, however, a commercial venture with the hope of profit; and this company did not forget the possibilities that were near at hand in its search for what it believed would be greater ones in the near future. The vessel which carried Capt. Newport on his second voyage in 1608 brought out also eight Poles and Germans to make pitch, tar, glass, mills, and soap-ashes, and the first exports of manufactures from what is now the United States were the results of the trials made at the first furnace erected in this country. It is said the works were destroyed at the massacre in 1622.

In 1795, the time from which this sketch is to be made, there is no record of any glass-works in Virginia. In the census of 1810 Virginia does not appear as a glass-making State. In the census of 1820 a glass-works is reported in Brooke County. It made that year $20,000 worth of glass; had $12,000 capital; paid out $8,000 for wages and $12,000 for materials and contingent expenses, or exactly the value of the product. It employed 14 men and 12 boys in 1827. It is reported that glass decanters of great beauty were made at these works, and white-flint and green-glass wares were made that rivaled the foreign. At the Tariff Convention in 1831 there were two flint-furnaces, with 12 pots, reported in operation in Wellsburg, and one, with 6 pots, at Wheeling, Va. Two window-glass furnaces were also reported at Wheeling. In 1840 one glass-works is reported in Brooke County (the Wellsburg), and three in Ohio County (the Wheeling).

The first mention of a glass-works in Pennsylvania is found in a letter written by William Penn, in August 1683, to the Free Society of Traders. In this letter he alludes to their tannery, saw-mill, and glass-works. Where these works were located, or what kinds of glass they made, is not known. In 1795 there was doubtless some glass made in Pennsylvania. A glass-house was sold on 6 March 1800, to Joseph Roberts, Jr., James Rutlans, and James Rowland, for $2,333, and was again sold in 1833 to Dr. T. W. Dyott. In eastern Pennsylvania, prior to 1831, a number of attempts seem to have been made with but little success, and the works carried on by Dr. Dyott were evidently looked upon as being of national importance. It is stated that President Jackson visited this establishment, which in 1833 consumed 15,000 barrels of rosin for fuel. From 250 to 300 men and boys were constantly employed; five furnaces were operated, which used both wood, coal, and rosin, melted 8,000 pounds of batch a day, and produced about 1,200 tons of glass a year, which was blown into apothecaries' vials, bottles, and shop-furniture. Dr. Dyott failed in 1838, and the works passed into other hands, and at this time are operated in the manufacture of green glass, and have quite a reputation for the making of demijohns.

Of early glass making in western Pennsylvania full accounts are given. It is claimed that Albert Gallatin commenced the first glass-works there at his settlement of New Geneva, 90 miles south of Pittsburg, on the Monongahela River. It seems to be generally accepted that the works were started in 1797, and were used for the manufacture of window-glass. The furnace was a small one, with 8 pots, using wood as fuel and ashes for alkali. The glass-house was 40 by 40; three sides frame and one side stone. One man could lift the pots, while now it would require four men to lift the pots used in window-glass works. The title of the firm was Gallatin & Company, but was afterward changed to the New Geneva Glass Works. It is said that for a time this enterprise was exceeding profitable, there being but two or possibly three other window-glass works in the country, most of the glass for that purpose being brought from England. The glass was sold at $14 per box of 100 feet, but was doubtless of inferior quality. A works at New Geneva was reported as late as 1832.

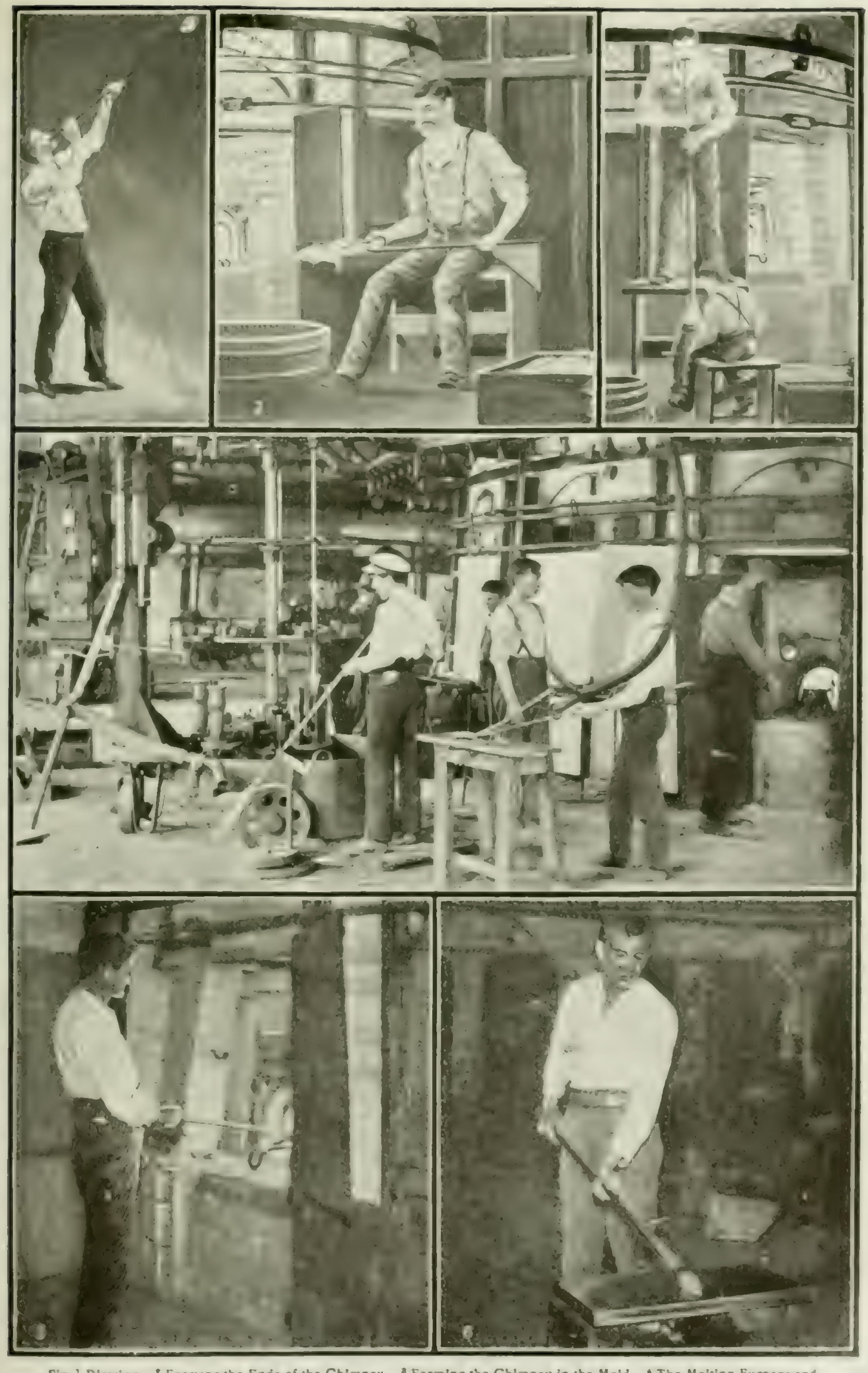


Fig. [1] Blowing. [2] Forming the Ends of the Chimney. [3] Forming the Chimney in the Mold. [4] The Melting Furnace and Blowing Machine. [5] Gathering Molten Glass on the Blowpipe. [6] Rolling the Glass to Conical Form before Blowing.

THE MANUFACTURE OF BLOWN GLASS—LAMP CHIMNEYS

In 1796 Isaac Craig and James O'Hara erected the first glass-house in Pittsburg. It is claimed that these were the first works west of the mountains to make glass, and they are said to have started a month before those of Gallatin. These were the first works to use coal as a fuel, and were located at the south side of the Monongahela River, just above where it unites with the Allegheny to form the Ohio. The site, or part of it, has been continuously occupied as a glass-works. The use of coal was an innovation, and even as late as 1810 this fuel was not used in any of the glass-works in the United States other than those in Pittsburg. O'Hara and Craig were the pioneers in its use, and to them should be given the credit. As was the custom in window-glass factories in those days, one or more of the pots were used for the making of bottles, and among O'Hara's papers, found after his death, was a memorandum in his handwriting, stating: "To-day we made the first bottle, at a cost of $30,000."

As in all new enterprises, and particularly the making of glass, it is only men of perseverance and determination who succeed; and had not Craig and O'Hara been men of that character the venture would have fallen the first year. As a rule, the men who are secured from old-established glass factories are really not the best men; and not only did the early manufacturers suffer from a lack of experience, but also from the fact that their employees were not always capable of doing the work they were engaged to do. And it may be said that at the present time no new works, established in a location in which glass has not been made, can make a profit of any moment the first two or three years; and the first year must invariably be counted as a losing one. Craig wrote to Samuel Hodgson, of Philadelphia, 5 Aug. 1803:

> With respect to our glass manufacturing, the establishment has been attended with greater expense than we had estimated. This has been occasioned partly by very extensive buildings necessarily erected to accommodate a number of people employed in the manufacture, together with their families, and partly by the ignorance of some people in whose skill of that business we reposed too much confidence. Scarcity of some of the materials at the commencement of the manufacturing was also attended with considerable expense. We have, however, by perseverance and attention, brought the manufacture to comparative perfection. During the last blast, which commenced at the beginning of January, and continued six months, we made on an average [illegible] boxes a week of excellent window-glass, besides bottles and other hollow ware to the amount of one third the value of the window-glass, 8 by 10 selling at $13.50, 10 by 12 at $15, and other sizes in proportion.

In the fall of 1807, George Robinson, a carpenter, and Edward Ensell, an English glass worker, commenced the erection of a flint-glass works in Pittsburg, on the banks of the Monongahela. They appear, however, to have lacked capital, and were unable to finish the establishment, which, without being completed, was offered for sale. In August 1808 Thomas Bakewell and his friend, Robert Page, were induced to purchase this plant, on the representation of Ensell that he thoroughly understood the business. This was the beginning of the firm of Bakewell & Page, which by itself and successors continued in the manufacture of flint-glass until some time after the census of 1880. Bakewell experienced the trouble usual in a new business. His furnace was badly constructed; his workmen were not highly skilled, and would not permit the introduction of apprentices; and his materials were received from a distance at a time when transportation was difficult and expensive, pearl-ash and red lead coming over the mountains in wagons from Philadelphia, and pot-clay from Burlington, N. J. The sand was obtained near Pittsburg, but was yellowish, and up to that time had only been used for window-glass and bottles. The saltpetre came from the caves of Kentucky until 1825, when the supply was brought from Calcutta. These difficulties in time were overcome; good clay was procured from Holland, and purer materials were discovered, and Bakewell rebuilt his furnace on a better plan, competent workmen being either instructed or brought over from Europe. Through his energy and perseverance the works became eminently successful, and there is no doubt that Bakewell is entitled to the honor of erecting and operating the first flint-glass works in this country. The furnace built or completed in 1808 held six 20-inch pots; this was replaced in 1810 by a 10-pot furnace, and in 1814 another furnace of the same capacity was added to the works. The establishment was burned down in the great fire of 1845, but was immediately rebuilt.

Massachusetts has played a very important part in the production of glass, which was manufactured as early as 1639 at Salem. But, from all the records that exist, the history previous to the Revolution was one of failure. Shortly after the Revolution, Boston recommenced the manufacture of glass, which for many years had been one of the leading industries. The new enterprise, the Boston Crown-Glass Company, which was really the first successful glass-works in this country, was greatly helped by the liberal action of the State. In July 1787 Messrs. Whalley, Hunnewell, and others received from the legislature a charter conferring upon them the exclusive right to manufacture glass in Massachusetts for 15 years, and imposing a fine of $500 upon anyone infringing on this right. The capital stock was exempted from all taxes, and the workmen from all military duty. To counteract the effect of the bounty paid by England on the exportation of glass from the kingdom, a bounty was paid for every table of glass made. Owing to the many difficulties incident to the starting of a new industry, the operation of making glass did not commence until 1792. The company commenced with the manufacture of crown window-glass, and in 1798 produced glass to the value of $82,000 per annum. This concern was incorporated in 1809, and under the influence of the State bounty the proprietors were encouraged to continue their efforts, and became very successful. The glass was said to be superior to the imported, and well known throughout the United States as "Boston window-glass." These works were continued until 1826, when the company failed, from bad management. This early establishment led to the commencement of many others, but none of them could be considered successful. Many attempts have since been made in Massachusetts to establish the manufacture of window-glass. In 1860 a large establishment was erected for the manufacture of sheet window-glass, but its operation proved unprofitable, and at this time there is only one window-glass works in the State, located in Berkshire County.

The manufacture of flint-glass grew out of the Essex Street works. Thomas Caines, an employee there, was also a skilful blower and

metal mixer. He prevailed upon the management to allow him to build a small 6-pot furnace in a part of their works at South Boston. This furnace was fully employed during the War of 1812, and was the beginning of the flint-glass industry in Massachusetts; but it was compelled to cease work, and although several attempts were made to operate it between 1820 and 1840, they all failed. About the time this furnace was started, the Porcelain and Glass Manufacturing Company built a factory at East Cambridge. The furnace was a small one, containing 6 pots. Workmen were brought from abroad, but it proved a failure. The plant in 1815 was leased to a firm of workmen, Emmet, Fisher & Flowers; but they failed to agree, and in 1817 the Porcelain Company sold the property at auction to the New England Glass Company. This was the beginning of one of the most successful glass companies in this country. The works, when they commenced, had a small 6-pot furnace, the pots holding about 600 pounds; 40 hands were employed, and they produced glass to the value of $40,000. It was really the foundation of the flint-glass industry in the United States. The management was broad and liberal from the beginning; for 50 years they led in the production of flint and colored glass of all varieties. Workmen were brought from abroad, and every means employed that capital and skill could compass to produce results equal to anything in the world. In 1865, which was probably the highest point reached in their history, they operated 5 furnaces of 10 pots each, each pot holding 2,000 pounds; 500 hands were employed, and glass to the value of $500,000 was produced yearly. The influence of the New England Glass Works has been felt all over the land, as many of their employees and managers have been the means of establishing the industry in other parts of the country. Fine blown, cut, and pressed glass were made in great variety. The works are not now in existence.

When the western manufacturer commenced to make lime-glass with bicarbonate of soda and lime, in place of lead and pearl-ash, the thought in the minds of the management of the New England Works was that its success would be only temporary, and they failed to meet the changed condition. A very large proportion of their production at this time was pressed glass, and for several years, in the attempt to meet the competition of the cheap products of the western manufacturers with their more costly products, the works were run at a loss, which amounted during the last year they operated to more than $40,000. In 1888 they ceased operation.

In 1825 a plant was established at Sandwich, commencing in a small way, with one 8-pot furnace, and melted 7,000 pounds of glass. In 1865 it had been increased to 4 furnaces, 10 pots each, and a melting capacity of 100,000 pounds weekly. It was in these works that the modern invention of pressing glass was first successfully introduced, in 1827. In 1888, after several years of financial loss, the company suspended operation. They had built up quite a town at Sandwich, and up to 1865 had been prosperous and successful, employing for 63 years a large number of people, and making a fine line of cut, blown, colored, and pressed glass.

During the period in which these two Massachusetts factories were in existence they were in the lead, and while a number of others had been established, none had reached the success of these two noted works, which are now only a part of the record. Quite recently an attempt has been made to operate one of the furnaces at Sandwich, the success of which is yet to be demonstrated. At this time there are only four flint-furnaces operated in Massachusetts, two of them being at New Bedford, one at Somerville, and one at Sandwich. There are, besides, the window and part-plate works at Berkshire. So that Massachusetts, that in 1860 led the flint-glass industry in this country, has almost ceased to be a factor at this time.

Maryland was quite an important State in the early production of glass, and the attention of Congress was called to the value of the industry by John Frederick Amelung, who petitioned Congress to extend its patronage to his works at New Bremen. A motion was made in Congress to loan him not exceeding $8,000, on his giving security for its repayment. The motion was debated for several days, during which was brought out the fact that Amelung had spent over $100,000, and brought over from abroad over 200 workmen, in his attempts to establish the industry. The motion was defeated. In 1794 Amelung presented a petition for an increase of duties. These works appear to have been built at Fredericktown, but were afterward moved to Baltimore. They were not a success, and it is probable he crossed the mountains and helped to start the flint-works at Pittsburg. A plant was established for the making of window-glass in 1790, known as the Baltimore Glass Works. These are the window-glass works operated by Baker Brothers until quite recently. They have operated them since 1852. Maryland, however, since that period, has been quite a glass State. Window-glass and green and flint bottles have been made to a greater or less extent.

One of the earliest glass-works in this country was located at Allowaystown, in Salem County, N. J. It was the beginning of the glass industry in that State, and was built about the year 1760 by a German named Wister, who carried on the works until his failure in 1775. The workmen then went to Glassboro, and established the industry there. Plenty of pine-wood for fuel was found in this locality, and a very fair grade of sand, which was good enough for bottles, jars, vials, and the common kinds of green glass made by them. Glass making has been carried on at this place ever since that time. The first establishment commenced with a 6-pot furnace, but gradually extended until a town surrounded it. In 1870 there were factories at 37 different localities. Many of them ran for only a short period. The cheapness of wood and sand no doubt led to the building of many, and the fact that expensive buildings were not required, most of them being frame structures. With the exception of a flint-works at Jersey City and one at Camden, the glass made in New Jersey was bottles, jars, vials, and window-glass.

In New York State large quantities of glassware have been made, and some of the works have had a national reputation. In January 1785 Leonard de Neufville and his associates, the proprietors of a glass factory located 10 miles from Albany, at Dowesborough, in the

midst of a well-wooded pine forest, applied to the legislature for aid in the undertaking, giving as a reason that $150,000 annually was sent abroad for glass. In 1793 the legislature of New York voted to loan them $3,000 for eight years without interest, and five years at 5 per cent, but by this time the works had passed out of the De Neufville family. The history of glass making in New York State shows that up to 1850 there had not been much headway made in establishing it on a permanently successful basis. Many factories were started, but ran for only a short time, and none of those in operation in 1850 are now in existence.

In 1820 some workmen left the New England Glass Works at East Cambridge and built a factory in New York city, under the firm name of Fisher & Gilland; but in 1823 the partnership was dissolved, and Gilland removed to Brooklyn, where he established what were known as the South Ferry Flint-Glass Works. Gilland up to 1850 was evidently very successful. He had the reputation of making the finest flint-glass made in this country, and at the London Exhibition in 1851 took a medal for the best flint-glass on exhibition. He afterward failed, and the works are not now in existence.

Like other industries in the United States, the history of the glass business was, between 1850 and 1860, one of great depression. Fine glass was made in New England and in New York and in one or two factories in Pittsburg, but the bulk of the product was of poor quality, and the window-glass did not in any way measure up to the imported glass. During this period, however, a great impetus was given to the flint-glass business by the making of coal-oil from coal and the later discovery of petroleum. The demand for lamps and lamp-chimneys was very extensive. One of the first to make a specialty of glass for lighting purposes was Christopher Dorflinger, who started with a capital of $1,000 in 1852, in Concord Street, Brooklyn. The furnace held 5 small pots, and was afterward increased to hold 7, until in 1861 he was operating 4 furnaces. The first year his sales amounted to $30,000, and he employed 85 people. When he left Brooklyn in 1865 his sales amounted to $300,000. The factories increased in Brooklyn, from 1858 to 1865, from 2 to 15, mostly making the same class of ware, which was principally for lighting purposes — lamp-chimneys, gas-globes, and lamps. In 1865 Dorflinger moved to White Mills, and established one of the best-known and largest of the manufactories of cut glass.

In 1860, from the best records we can get, the product of the glass factories did not exceed $7,000,000. 1861 and 1862 were off years. The excitement incident to the commencement of the War produced great depression, but from 1862 until 1870 the increase in production was very great, and the census showed 154 establishments, with 15,367 employees, producing glass to the value of $16,470,507, with a capital invested of $[illegible]42. It was during this decade that great improvements were made in the making of pressed glass. The modern discovery of pressing glass was an American invention, and the credit is given to the Sandwich Glass Company, which, at the solicitation of a carpenter, in 1827 made a mold to press an article he wanted made. After that the mold increased rapidly in favor, but was used only for the commoner class of goods for many years, until the New England Glass Company, by a series of expensive molds, had produced some very fine effects in pressed glass. The triumphs of pressed glass in this country, however, came from Pittsburg. James B. Lyons, of the O'Hara Glass Works, Pittsburg, made for many years pressed glass only, and in 1867 made an exhibit at the Paris Exposition, and took the first prize for fine pressed glassware. Goblets and wine-glasses were made almost as fine and delicate as those made by the old mode of blowing and cutting. Prior to 1864 the pressed glass was either made of flint-glass, the ingredients of which were the best of sand, pearl-ash, refined saltpetre, and oxide of lead, and was a very good crystal glass, or from what was then known as German flint or lime glass, the ingredients of which were soda-ash, lime, nitrate of soda, and sand. This latter made a very inferior glass, apt to crack, and very poor in appearance. It was used principally in common tumblers and some lamp-chimneys.

In the winter of 1864, William Leighton, Sr., of the firm of Hobbs, Brockunier & Company, of Wheeling, made a series of experiments with bicarbonate of soda, with pure sand, lime, and refined nitrate of soda, and produced a very clear, brilliant glass, at a cost for the batch of not more than one third that of the lead-glass or flint batch. The result was a complete revolution in the pressed-glass business. It was impossible for the manufacturer making flint-glass to compete, and the result was that all had to adapt themselves to the change, and some were driven out of the business. Up to 1870 there had been very little change in the furnaces, which were mostly the old-fashioned type of round furnace, with the coal fired over the bench, or the Frisbie bucket-teaser, where the coal was pushed up from below. But the close competition and the desire for increased production led to the effort to get better results from the furnaces, and after 1870 larger furnaces were built, into which, by a series of flues, hot air was introduced to the combustion-chamber, and much greater heat secured with much less fuel. Many of the furnaces also hold from 13 to 15 pots, and many of the pots each hold two tons of glass.

The Centennial Exhibition held in Philadelphia gave a large impetus to so many industries. One of the great attractions was the glass works operated by Gillinder & Sons, of Philadelphia. It was a complete establishment, showing the processes of melting, blowing, pressing, cutting, etching, and annealing. The furnace held six pots and melted double the amount of glass made by the first flint-glass works operated in this country by Bakewell & Page, in 1808. This was the first time anything of this kind was attempted in an international exhibition. The product was sold as souvenirs, and realized $96,000. Over $14,000 was paid to the Centennial Board of Finance as commission on the sales.

At the close of 1880 the glass trade was in a very prosperous condition. Prices were good, and the outlook looked promising for the future; and it is from this period we must date the wonderful progress of plate-glass making in this country. In 1880 there were but four plate-glass works in this country, and only three in operation. They were located at New Albany,

Ind., Jeffersonville, Ind., Crystal City, Mo., and Louisville, Ky., the latter plant being idle. The first attempt to make plate-glass was made in 1852, when Tilton, Pepper & Scudder started a factory at Williamsburg, L. I. The works were under the management of Cuthbert Dixon, a plate-glass worker from the Thames Plate-Glass Works, London, England. They produced a good quality of rough plate, but, owing to the ruinous competition of the English and German manufacturers, at the end of two years they were compelled to close. There is some dispute as to where the first plate-glass was made in the United States, but there are existing proofs that the Williamsburg works were the first, based upon the records found in an old diary of the late William S. Dixon, of Pittsburg, who was employed there as pot maker, his father being the manager.

Attempts were made to make plate-glass at Cheshire, Mass., Lenox Furnace, Mass., and at Greenpoint, L. I., previous to 1860. There are records of polished plate-glass being made at Lenox in 1865, but it was not continued. The successful founder of the plate-glass industry in this country is James B. Ford, of Pittsburg. In the year 1869 Ford conceived the idea of making polished plate-glass, and with this in view visited the works at Lenox, gathered what information he could from the workmen who had been imported from abroad, and returned to New Albany with the determination to make plate-glass. Machinery for this purpose was imported, and the new plant was speedily successful so far as the production of plate-glass was concerned; but, like all new enterprises of the kind, it was not profitable, and in 1872 Ford withdrew. The factory was continued by William C. de Pauw until his death, and afterward by his heirs. He demonstrated, after a hard struggle, that polished plate-glass could be made here at a profit. Mr. Ford afterward built a factory at Louisville, Ky. It had two 12-pot furnaces and was equipped with the old-style French machinery. He ran these works for two years and sold out, removing to Jeffersonville, Ind., where he built a plant that he operated until he moved to Creighton, Pa., in 1881. Shortly after the building of the New Albany plant, E. B. Ward, of Detroit, and others, attracted by a very extensive deposit of sand of fine quality, originated the American Plate-Glass Company, with a capital stock of $250,000, and began in 1872 the erection of works at Crystal City, Mo. The capitalization was increased in 1874 to $500,000, and the works were operated until 1876, producing some glass of good quality; but, owing to lack of experience, the management failed to make a profit. In 1877 the works were reorganized, new capital was secured, A. E. Hitchcock, of St. Louis, president of the old company, continuing in charge. G. F. Neal, a practical plate-glass manager, took charge of the works, and a Siemens furnace was erected. The works have been largely increased, and plate-glass is made in Crystal City equal to any found in Europe. This was the condition of the plate-glass business when Ford built the Creighton Works in the midst of a rich gas-coal country. He built a factory with a capacity of 70,000 square feet per month. It was equipped with two 16-pot furnaces, 8 grinding and 16 polishing machines. This was really the first plate-glass works in this country that paid for the large investment required in its establishment.

While the success of these works was very largely helped by the experience that Ford had gained from his previous ventures, a new factor was introduced that had never been used in the making of plate-glass before. This was natural gas, which it was found could be used as a fuel. The Rochester Tumbler Works had used it in their leers, and partially in their furnaces, as far back as 1875; but not having sufficient for the furnaces, it was not a success. At about the time Mr. Ford was starting at Creighton, wells had been drilled that promised inexhaustible quantities of the new fuel. For glass making it is impossible to conceive of a more perfect fuel — no labor required for firemen, no dirt, no ashes, and a uniform heat, or just what was required. Natural gas was a great factor in the success of these works, which were sold by Ford to the Pittsburg Plate-Glass Company, who enlarged them in 1883, and increased the output from 70,000 square feet to 110,000 square feet finished product. Having a great desire to own and operate his own works, Ford, in 1884, commenced the building of a plant at Tarentum, Pa., with a capacity of 150,000 square feet per month. Before it was completed the Pittsburg Plate-Glass Company made him an offer, which he accepted, and the Tarentum plant became part of the Pittsburg Plate-Glass Works. The success of their plants resulted in the building of plate-glass works at Butler, Pa., in 1886, and at Cochran Station, Pa., in 1889.

Natural gas had been discovered in Indiana. A large plant was built at Kokomo, Ind., under the name of the Diamond Plate-Glass Company. The gas being in abundance, this same company erected another large factory 20 miles away, at Elwood, in 1891; and the extensive works at Charleroi and at Irwin, Pa., were erected the same year. The Pittsburg Plate-Glass Company in 1887 commenced the erection of what are now the largest plate-glass works in the world. The company bought 480 acres of land, and a town was laid out, and named Ford City, in honor of J. B. Ford, who is one of the largest stockholders. Under his personal supervision the works were built, which have a monthly capacity of 400,000 square feet. In 1891 the De Pauw Plate-Glass Company built a small plant at Alexandria, in the heart of the gas belt; but the panic of 1893 caused its suspension, and it has not been operated since.

The works mentioned have an aggregate monthly capacity of 1,785,000 square feet, or an annual maximum production of 21,420,000 square feet. In 1894 a movement was made by some of the companies for self-preservation, which resulted in the outright purchase by the Pittsburg Plate-Glass Works of all the plate-glass works in the United States, with the exception of those at Butler and Irwin Station and the De Pauw plants of Indiana.

The total number of furnaces is 43 of 20 pots each, and 2 of 16 pots each. Of this number there are in operation at this time only 23 furnaces, containing 460 pots. Plates of glass are made containing 180 square feet, or, say 12 by 15 feet. The success of the plate-glass business, which really dates back only 20 years, is one of the wonders of our age. Much credit must be given to J. B. Ford, and especially when we consider that when the factory at Creighton was

started he was over 70 years of age, and had to impress upon the capitalists his own faith that the business could be made to pay. So far as Pennsylvania was concerned it was an entirely new venture, the census of 1880 showing that no plate-glass was then made in Pennsylvania.

From the year 1880 may be dated also the great success of window-glass making. Prior to this time, with few exceptions, the old furnaces and flattening-ovens that had been in use for 50 years were still prevailing. Fully 25 per cent of the window-glass used in this country was imported. For many years the workmen have been organized into a union, which not only takes in the blowers, but the gatherers, flatteners, and cutters; these last two being practically unskilled labor, and paid as such in European countries. Then, to mend matters and make competition worse, the manufacturers of Belgium and England had adopted what is known as the tank-furnace; no pots were required, a more uniform quality of glass could be depended upon, and a much larger production. James Chambers, of Pittsburg, who had succeeded his father in the manufacture of window-glass, was in 1887 operating 4 furnaces with 36 pots, using natural gas in his furnace and flattening-ovens. He had the improved flattening-ovens, but he came to the conclusion that something had to be done to put the window-glass business upon a better basis. He made a trip to Europe, obtained all the information possible, came back to Pittsburg and organized the Chambers & McKee Company, and, as president, planned, built, and operated the plant at a place on the Pennsylvania Railroad, 27 miles east of Pittsburg, called Jeanette. The foundation of the tanks was laid in 1888, and in the spring of 1889 they commenced making glass. Glass workers and manufacturers all over the country, with few exceptions, had predicted that the tanks would be a failure, and that window-glass could not be made that way; but the tanks were a success from the first.

Owing to financial disagreement, Chambers withdrew from the Chambers & McKee Company, and in 1892 formed a company and erected a factory at New Kensington, 10 miles from Pittsburg, on the Allegheny Valley Railroad, and built two continuous tanks that are said to be the largest in the world. They are 25 feet 6 inches wide, 130 feet long, inside measure; each furnace will hold 1,000 tons of molten glass, and has a melting capacity of 35 tons, turning out 600 boxes of single and 300 boxes of double strength every 24 hours. This is said to be the largest and most complete establishment in the world for the manufacture of window-glass.

The discovery of natural gas, and its application to the glass-furnaces, led to a very great increase in the building of flint- and green-glass works. To-day probably the largest flint-bottle works in the world are those of the Illinois Glass Works at Alton, where 4,500 people are employed. Here was blown in 1903 the largest glass bottle in the world. The next largest bottle works are those of Whitall, Tatum & Company, located at Millville, N. J. They have 13 flint-furnaces, in addition to 5 green-glass furnaces and a green-glass tank, and employ from 1,500 to 1,000 employees, according to the demand for their goods. This business has been principally built up since 1860. The Rochester Tumbler Company, at Rochester, Pa., was organized in 1872, and commenced making glass in July of the same year. They commenced with one 10-pot furnace and 90 employees, making a specialty of tumblers, and with a capacity of 12,000 dozen per week. At present they operate 7 furnaces with 88 pots, with a capacity of 75,000 dozen per week, or 150,000 tumblers each day. The melting capacity of the furnaces is 120 tons of sand per week. The pots are very large, and over 1,000 hands are employed. When they first commenced they made only common tumblers, but now they make every kind of tumblers, with a cutting, engraving, and decorating department. The works cover over seven acres of ground. They make their own barrels, boxes, and machinery, and almost everything used for the manufacture of glass. All the fuel used is natural gas. They do some export trade — probably more than any other concern in this country — and without question have the largest plant in the world making a specialty of tumblers.

The discovery of natural gas was the means of largely stimulating the erection of flint-glass furnaces, and many small towns offered land and a bonus in money to have a glass-works established in their boundaries. By this means many works were started by parties who had little knowledge of the business, so that the business was largely overdone, and prices in 1891 were such that little or no profit could be made. Labor was high, and, in view of there being so much demand for it, was aggressive and unreasonable in its claims, being backed up by its labor organizations. A number of manufacturers met together and formed a stock company under the name of the United States Glass Company, which company bought up 15 of the largest and most complete press manufacturers in the country, located in Pennsylvania, Ohio, and West Virginia. The 15 establishments had a capacity of 29 furnaces. The company afterward erected a plant at Gas City, Ind., with three 15-pot furnaces, to get the benefit of the natural gas fuel. The capital stock of the company was $4,158,100, $640,000 of which is preferred and $3,518,100 common stock. The first year of its existence as a corporation the sales amounted to very nearly $3,000,000. With a view of consolidating the plants the company bought 500 acres of land on the Monongahela River adjoining McKeesport, Pa., and erected two 15-pot furnaces. It is without question the largest flint-glass works in the world, and is almost able to supply this country with table-glass, if all the furnaces were in full operation. Quite a number of flint-glass works are operated in the making of glass for lighting purposes — arc globes, gas-globes, and shades for electric lighting. There are six leading companies making these goods, four of them located in Philadelphia, one at Monaca, Pa., and one at Brooklyn, N. Y.

Gillinder & Sons, of Philadelphia, were the first of these works established, and operations were commenced in 1861 by William T. Gillinder, the father of the present owners. Their works have two furnaces, with 23 pots, and have a capacity of production to the amount of $400,000 per annum. It is impossible to continue further to enumerate special plants, but so far as glass making is concerned America is practically in-

dependent. We have sand in almost every State of the Union fit to make glass. The sand of Massachusetts, Pennsylvania, and Missouri is equal to, if not better, than any other sand in the known world. Soda-ash and other chemicals are being made, and when the beet-sugar industry is fully established we shall be able to get pearl-ash from the ashes of the beet, so that it will not be necessary to import our potash from Germany. We have fire-clay for furnaces, which is found in many States of the Union, notably in New Jersey, Ohio, Pennsylvania, and Missouri. The pot-clay found near St. Louis, Mo., has been used for more than 40 years. It is a very superior clay, and for the making of glass-house pots is unsurpassed. It is capable of resisting a very high degree of heat, and will stand the changes of temperature much better than the most celebrated clays of Europe.

In the preparation of this article I have been aided very much in the early records by the 'History of Glass Making in the United States,' prepared by Joseph D. Weeks; and for information in regard to the various improvements in furnaces and leers, by H. L. Dixon, of Pittsburg, who has been identified with the building of many of the improved furnaces that have taken the place of the old furnaces. See GLASS.

JAMES GILLINDER,
Franklin Flint-Glass Works, Philadelphia.

The following statistics from the United States census report for 1900 will be found valuable for comparison with the figures heretofore given :

COMPARATIVE SUMMARY OF THE GLASS TRADE, 1850 TO 1900.

	DATE OF CENSUS			
	1900	1890	1870	1850
Number of establishments	355	294	201	94
Capital	$61,423,903	$40,966,850	$14,111,642	$3,402,350
Salaried officials, clerks, etc., number	2,268	[2] 1,095	(3)	(3)
Salaries	$2,792,376	[2] $1,232,561	(3)	(3)
Wage-earners, average number	52,818	44,892	15,822	5,668
Total wages	$27,084,710	$20,885,961	$7,846,425	$2,094,576
Men, 16 years and over	42,173	36,064	11,505	5,571
Wages	$24,901,233	$19,546,351	(3)	(3)
Women, 16 years and over	3,529	1,885	715	97
Wages	$840,001	$332,245	(3)	(3)
Children, under 16 years	7,116	6,943	3,602	(3)
Wages	$1,343,476	$1,007,365	(3)	(3)
Miscellaneous expenses	$3,588,641	$2,267,696	(4)	(4)
Cost of materials used	$16,731,009	$12,140,985	$6,133,168	$1,556,833
Value of products	$56,539,712	$41,051,004	$19,235,862	$4,641,676

[2] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. [3] Not reported separately. [4] Not reported.

RANK OF STATES ACCORDING TO VALUE OF PRODUCTS, 1880 TO 1900.

STATES	Rank			Value of Products		
	1900	1890	1880	1900	1890	1880
United States	....	....	....	$56,539,712	$41,051,004	$21,154,571
Pennsylvania	1	1	1	22,011,130	17,179,137	8,720,584
Indiana	2	4	8	14,757,883	2,995,409	790,781
New Jersey	3	3	2	5,093,822	5,218,152	2,810,170
Ohio	4	2	4	4,547,083	5,649,182	1,549,320
Illinois	5	6	6	2,834,398	2,372,011	901,343
New York	6	5	3	2,756,978	2,723,019	2,420,796
West Virginia	7	9	9	1,871,795	945,234	748,500
Missouri	8	8	5	765,564	1,215,329	919,827
Maryland	9	7	10	557,895	1,256,697	587,000
Massachusetts	10	10	7	418,458	431,437	854,345
Wisconsin	11	13	....	(1)	(1)	(2)
California	12	14	13	(1)	(1)	140,000
Virginia	13	....	....	(1)	(2)	(2)
Delaware	14	16	....	(1)	(1)	(2)
Georgia	15	12	....	(1)	(1)	(2)
Michigan	16	17	14	(1)	(1)	90,000
Colorado	17	15	....	(1)	(1)	(2)
Kentucky	....	11	11	(2)	(1)	388,405
Connecticut	....	....	12	(2)	(2)	160,000
New Hampshire	....	....	15	(2)	(2)	70,000
Iowa	....	....	16	(2)	(2)	3,500
All other states[4]	....	....	....	924,706	1,065,397	....

[1] Included in "all other states."
[2] Not reported.
[4] Includes the following states: 1890 — California, Colorado, Delaware, Georgia, Kentucky, Michigan, Wisconsin; 1900 — California, Colorado, Delaware, Georgia, Michigan, Virginia, Wisconsin.

TABLE SHOWING [illegible] BY STATES, 1880 TO 1900.

States	Year	Window [illegible]	Plate [illegible]	[illegible] and [illegible]
United States	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	1880	[illegible]5,618	[illegible]	[illegible]
Illinois	1900	......	[illegible]	[illegible]
	[illegible]	......	[illegible]	[illegible]
	[illegible]	373,[illegible]	[illegible]	[illegible]
Indiana	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	1,831,[illegible]	[illegible]	[illegible]
	1880	[illegible]797	[illegible]	[illegible]
Kentucky	[6]1900	......		
	[illegible]	......		
	[illegible]	3,512	[illegible]	[illegible]
Maryland	[illegible]	......	......	[illegible]
	[illegible]		......	[illegible]
	[illegible]	[illegible]	......	[illegible]
Massachusetts	[illegible]	[illegible]	......	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	149,845	[illegible]	[illegible]
Missouri	1900	......	......	......
	[illegible]	......	......	......
	[illegible]	[illegible]	[illegible]550	[illegible]
New Jersey	[illegible]	[illegible]	......	[illegible]
	[illegible]	1,316,[illegible]	......	[illegible]
	[illegible]	[illegible]	......	[illegible]
New York	1900	346,790	......	[illegible]
	1890	......	......	[illegible]
	1880	[illegible]	......	[illegible]
Ohio	1900	671,4[illegible]	......	[illegible]
	1890	......	......	[illegible]3,385
	1880	[illegible],000	......	1,191[illegible]
Pennsylvania	1900	[illegible]	3,91[illegible]	[illegible]7,585
	1890	6,40[illegible]	[illegible]	[illegible]
	1880	[illegible]	......	[illegible]
West Virginia	1900	......	......	[illegible]
	1890	......	......	[illegible]34
	[illegible]	......	......	[illegible]500
All other states[7]	[illegible]	[illegible]518	[illegible]	[illegible]
	[illegible]	4,[illegible]	[illegible]	[illegible]
	1880	[illegible]	......	373,500

[illegible] as follows: [illegible] 1; Michigan, 1; Virginia, 2; Wisconsin, 1. 1890 [illegible] Kentucky, 2; Michigan, 1; Wisconsin, 1. [illegible] California, 1; Connecticut, 1; Iowa, 1; Michigan, [illegible] New Hampshire, 1.

[4] Includes "all other products" for building glass as follows: Indiana, $15,000; New Jersey, $6,400; and Massachusetts, $[illegible] total, $[illegible]

[5] Includes "cathedral," "skylight," "wire," and "all other products" for this class.

[6] No establishments reported.

[7] Included in "all other states."

QUANTITY AND COST OF MATERIALS USED, 1890 AND 1900, WITH PER CENT OF INCREASE

	1900	1890	Increase	Per cent of increase
Total cost	$[illegible]1,009	$12,14[illegible]	$[illegible]	37.8
Glass sand, tons	[illegible]	[illegible]	[illegible]	[illegible]
Cost	$[illegible]	$[illegible]	[illegible]	[illegible]
Soda ash, tons	[illegible]	[illegible]	[illegible]	63.0
Cost	$[illegible]9,939	$[illegible]	[illegible]	[illegible]
Salt cake, tons	[illegible]	[illegible]	[illegible]	[illegible]
Cost	$[illegible]	$[illegible]	[1] [illegible]	[1] 14.2
Nitrate of soda, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cost	$[illegible]	$[illegible]	$[illegible]	15.3
Limestone, tons	[illegible]	[illegible]	[illegible]	[illegible]
Cost	$181[illegible]	$[illegible]	[illegible]	33.2
Lime, hundred[illegible]	794[illegible]	[illegible]	[illegible]	6.8
Cost	$147[illegible]	[illegible]	[1] $[illegible]191	[1] [illegible]
Arsenic, pounds	2,349[illegible]	[illegible]	[illegible]	[illegible]
Cost	$112,[illegible]	[illegible]	[illegible]	[illegible]
Manganese, pounds	[illegible]	[illegible]	[illegible]	[illegible]
Cost	$[illegible]	$31[illegible]	[illegible]	85.0
Litharge, pounds	[illegible]	[illegible]	[illegible]	[illegible]
Cost	$[illegible]	$[illegible]	$[illegible]	[illegible]
Potash or pearlash, pounds	[illegible]	[illegible]	[illegible]	[illegible]
Cost	$[illegible]	$13[illegible]	$51,800	[illegible]
Grinding sand, tons	[illegible]	[illegible]416	[illegible]	[illegible]
Cost	$16[illegible]	$[illegible]	$[illegible]	[illegible]
Fire clay or pot clay, [illegible]	[illegible]	[illegible]	[1] 4,91[illegible]	[illegible]
Cost	$221,183	$[illegible]	[1] $107[illegible]	[illegible]
Pots, not including those [illegible] number	[illegible]	8,006	[illegible]	[illegible]
Cost	$38[illegible]	$393[illegible]	[1] $1[illegible]	[illegible]
Fuel, cost	$[illegible]	$[illegible]	$[illegible]	[illegible]
Packages and packing [illegible], cost	$[illegible]	$[illegible]	$[illegible]	[illegible]
All other materials, cost	$[illegible]	$[illegible]	$[illegible]	[illegible]

[1] Decrease.

VALUE OF GLASS IMPORTED AND EXPORTED: 1869 TO 1900.

YEAR	IMPORTS.										EXPORTS		
	Total value	Bottles, vials, carboys, etc.[2]	Cylinder and common window glass, unpolished	Cylinder and crown glass, polished.		Plate Glass			Glass plates or disks for optical instruments[4]	All other	Total value	Window glass[5]	All other
				Unsilvered	Silvered[3]	Fluted, rolled, or rough	Cast, polished, unsilvered	Cast, polished, silvered					
1900	$5,037,931	$464,483	$1,555,924	$539,082	$286	$7,915	$226,295	$12,413	$125,449	$2,106,084	$1,936,119	$36,218	$1,899,901
1899	4,303,660	371,394	1,275,184	521,957	622	9,528	233,190	419	119,832	1,771,534	1,503,651	32,690	1,470,961
1898	3,782,617	338,861	953,116	569,380	66,768	9,880	161,637	562	107,572	1,574,841	1,211,084	23,480	1,187,604
1897	5,603,868	600,308	1,181,696	301,412	772,296	18,245	285,485	21,870	94,242	2,328,314	1,208,187	13,369	1,194,818
1896	7,528,420	382,101	1,067,999	190,704	1,158,321	23,486	773,250	34,119	92,628	3,805,812	1,062,225	14,994	1,047,231
1895	6,627,473	531,904	835,730	61,212	782,778	23,990	684,131	16,740	85,794	3,605,194	946,381	11,140	935,241
1894	5,288,697	506,183	1,067,787	22,314	786,004	38,121	449,086	75,106	71,881	2,272,215	922,072	19,311	902,761
1893	8,082,639	739,037	1,496,326	91,559	1,679,185	70,493	829,596	154,404	60,898	2,961,141	973,827	10,229	963,598
1892	8,828,952	827,761	1,674,679	158,464	1,549,968	56,162	887,626	119,201	69,988	3,485,103	942,302	10,238	932,064
1891	8,463,935	926,010	1,475,338	91,248	1,912,391	78,030	1,351,808	183,015	99,623	2,346,472	868,374	11,244	857,130
1890	7,411,343	912,704	1,461,736	74,546	1,529,401	84,715	931,323	249,819	58,830	2,108,269	882,677	8,910	873,767
1889	7,724,662	825,411	1,444,982	91,105	756,577	130,172	983,316	1,243,455	10,741	2,238,903	894,200	16,864	877,336
1888	7,867,263	815,564	1,397,898	95,147	59,208	131,224	1,258,736	1,801,514	12,538	2,295,434	881,628	10,733	870,895
1887	7,336,771	739,240	1,420,159	85,500	1,262	90,899	1,191,134	1,647,154	16,876	2,144,547	883,504	15,955	867,549
1886	6,358,085	609,435	1,360,955	27,807	....	107,057	907,267	1,528,379	19,988	1,797,197	773,878	8,246	765,632
1885	6,256,194	590,160	1,630,844	18,287	189	118,693	900,461	1,192,147	....	1,805,413	783,915	10,055	773,860
1884	7,552,498	521,787	2,431,068	28,695	....	101,777	959,817	1,387,728	....	2,121,626	839,756	18,665	821,091
1883	7,762,543	....	1,736,700	62,630	....	62,898	1,145,709	1,226,432	....	3,528,174	998,857	....	998,857
1882	6,634,371	....	1,387,257	27,117	....	56,407	1,183,482	943,706	....	3,036,402	864,235	....	864,235
1881	5,878,025	....	1,414,709	57,754	....	32,422	979,452	833,385	....	2,560,303	756,022	....	756,022
1880	5,221,511	....	1,439,447	15,601	....	22,799	835,496	911,144	....	1,997,024	749,866	....	749,866
1879	3,222,479	....	595,070	11,110	....	6,527	699,459	575,549	....	1,334,764	768,644	....	768,644
1878	3,345,149	....	812,612	7,168	....	5,685	885,823	572,066	....	1,061,795	869,682	....	869,682
1877	3,936,786	....	1,006,456	8,482	....	14,405	1,263,864	552,899	....	1,090,680	658,061	....	658,061
1876	4,806,948	....	1,292,020	5,448	....	29,069	1,358,881	773,423	....	1,348,107	628,121	....	628,121
1875	5,805,115	....	1,656,040	21,166	....	47,265	1,620,032	887,847	....	1,572,765	691,310	....	691,310
1874	6,257,964	....	1,881,368	14,933	....	34,237	1,655,909	961,512	....	1,710,005	631,827	....	631,827
1873	7,420,044	....	2,759,728	21,217	....	34,180	1,550,857	823,076	....	2,230,986	627,562	....	627,562
1872	5,834,712	....	2,103,827	23,931	....	17,697	1,063,810	803,487	....	1,821,960	547,112	....	547,112
1871	4,269,620	....	1,447,292	16,738	....	26,191	919,435	651,487	....	1,208,477	466,447	....	466,447
1870	4,157,634	....	1,459,067	18,501	....	24,684	820,252	615,347	....	1,219,783	530,654	....	530,654
1869	3,895,739	....	1,466,138	25,885	....	22,173	717,952	625,338	....	1,038,253	580,718	....	580,718

[2] Included in "all other" glass and glassware imported previous to 1884.
[3] Included in "unsilvered cylinder and crown glass, polished" previous to 1885.
[4] Not separately reported previous to 1886.
[5] Included in "all other" glass and glassware exported previous to 1884.

FLINT OR GLASS SPONGES

Glass Painting. See GLASS STAINING.

Glass Snail, one of the minute, grass-haunting, hyaline land-snails of the genus *Vitrina.*

Glass-snake, or **Joint-snake,** a limbless, snake-like lizard of the genus *Ophisaurus* (family *Anguidæ*), which takes its name from the brittleness of the tail, which is more than twice the length of the body, and whose vertebræ are so slightly connected, that a part or all of the tail will easily break off, or may be cast off; but the lost part is quickly renewed. The head is very lizard-like. No vestige remains of limbs except two little spikes near the vent; the body is serpentiform, but the stiff armor of scales prevents the graceful movements of a serpent. The glass-snake (*O. pallasi*) of southeastern Europe may exceed a yard in length, and dwells in bushy districts where it can hide under leaves and sand, and catch snails and small animals. A smaller species (*O. ventralis*) is found in the Mississippi Valley and the southern United States. It is greenish-gray or brownish; sides largely yellow, with narrow black streaks; but the coloration varies greatly, especially in western specimens. Several nearly related species inhabit Central America. These lizards are rapacious and devour great numbers of ground-keeping insects and crayfish. They breed by means of eggs hidden in loose soil or leaves; and are of slow growth. They are said to be easily tamed, and to show intelligence.

Glass-sponges, certain silicious sponges are so-called from the fact that the fibres or spicules composing their solid framework or skeleton is like finely spun glass. The glass-sponges, such as the Venus' flower-basket (*Euplectella*) and allied forms, live in fine sandy mud in deep water. The *Euplectella* inhabits the ocean around the Philippine Islands in from 10 to 20 fathoms. It forms a hollow cylinder or basket-work of spicules, enlarging at the top, which is broad and a little convex; it grows rooted in the sandy mud, anchored by its long glass spikes, which at the extremity end in anchor-like hooks. A number of similar but shorter, more dense sponges (*Holtenia*, etc.) live at great depths in the Atlantic, one kind occurring in shallower water (100 fathoms) in the Gulf of Maine. The glass-sponge of the Japanese seas is *Hyalonema*, in which the stem is twisted, composed of fibres, like spun glass, while the body of the sponge is long and slender; it grows nearly three feet in length. These glass-sponges, with the spicules having three crossed axes, or six threads radiating from a common point, are grouped in a family (*Hexactinellidæ*). The efferent canals are loosely meshed, while the digestive chambers (ampullæ) are large and barrel-shaped.

Glass Staining and Glass Painting, the art of producing pictures on glass with vitrifiable colors; but a common extension of the meaning is to include all the make and design of ornamental glass windows. Originally there was but one method of making these, and that was to produce the pattern in outline with frames, into the grooves of which pieces of colored glass or of stained glass were fitted. In the Moslem East these frames were of plaster, or rarely of marble slabs pierced with openings. In Europe, since the 12th century, these frames have been of lead, rolled or drawn into what are called *cames*, that is, bars of an I section, the two grooves holding the glass firmly. Modern chemistry has so improved the art of glass staining, that large pictures may now be produced on single sheets of glass, but nowhere have such pictures been successful in an artistic sense. In the original painted glass windows the pictures resembled tables of mosaic work, in which there was no attempt at shading or modification of the tone. What is perhaps the earliest known application of colored glass to window decoration, in Europe, is that in the monastery of Tegernsee, in Upper Bavaria, which was secularized in 1802, and is now a private residence. The windows of this structure, executed in the latter half of the 10th century, like all the first attempts, were only tasteful arrangements of colored glass in a translucent mosaic.

In the early part of the 13th century the mosaic patterns gave way to more elaborate designs, not only in beautiful Arabesques, but even in pictorial composition. In all these the figures were composed of pieces of colored glass combined with marvelous skill and taste. The work of shading and making so-called half-tints was not attempted; but an effect not dissimilar was got by painting in opaque pigment upon the glass and breaking up this painted surface into patchings and spots, as when an artist draws in crayon or charcoal. The finest English examples of this early mosaic work are to be found in the cathedrals of Canterbury, Salisbury and Lincoln. In the 14th century the art of shading was advanced by removing certain portions of the colored surface. The first period of the art reached the culminating point in the 15th century, but with the passing of Gothic architecture, glass painting lost its artistic spirit. Subjects in which were arranged a multitude of personages with all the elaborate artifices of pictorial composition; buildings showing complex linear perspective; foreshortened figures; the play of light and shade — all this was attempted to be exhibited in painted windows. It soon became apparent that the true art was lost, and though windows continued to be painted, only a few artists acquired celebrity. Perhaps the best examples of the 15th century period are the windows of the Cologne cathedral.

About 1600, Bernhard von Linge, an artist from the Netherlands, residing in England, and who may be considered the father of the modern art of glass staining, established a school in London, whose influence is evident in the work of the present day. Francis Eginton (1737–1805), a native of England, accomplished much to restore the art during the 18th century. Among his numerous works, all of which are remarkable for brilliancy of coloring and delicacy of execution, are: 'The Banquet of the Queen of Sheba' (a copy from Hamilton); two 'Resurrections' (from Sir Joshua Reynolds); 'Christ Bearing the Cross' (from Morales); and 'The Soul of a Child' (from Peters). Other famous artists of this period were Jouffrey and Baumgartner. The Renaissance in glass painting was contemporaneous with the revival of Gothic architecture in the beginning of the 19th century. Four German artists, Mohn, Scheinert, Ligm and Frank, were

prominent as glass stainers during the century. In 1850, through the generous assistance of King Louis of Bavaria, a school was founded at Munich under the direction of Gartner and Hess, the latter a well-known historical painter, which obtained a world-wide celebrity. Still, however, the purists in Gothic art, and those who were most concerned in the Gothic Revival would have none of this glass of the early 19th century. It was seen that the smooth and clear modern glass would never do; and rough, partly opaque, flawed and bubbled glass was prepared on purpose. This material, known as "antique" and as "cathedral" glass, and by other names, allowed of a far more decorative effect.

In 1902 the chief centres of the art in Europe were at Birmingham, England; Edinburgh, Scotland; Paris and Sèvres, France, and Munich, Metz and Nuremberg in Germany.

Not until comparatively late in the 19th century did the art of glass staining obtain a place in the United States. Only a few years ago Americans were seemingly content with imported windows, or with poor imitations made here. In both cases the windows were but copies of mediæval work, seldom equaling the originals, and never showing an advance, either in artistic qualities or improvement of method over the windows of the Middle Ages. Several artists and some makers of church furniture began making fine windows, and to-day largely through their efforts American colored glass-windows have become celebrated for their color values and their color relations. John La Farge, Louis C. Tiffany and other American artists in glass painting and glass staining took up the art where the mediævalists stopped, in the study of the inherent properties of the glass, both in their color and texture, in order to obtain in the glass itself light and shade, through depth and irregularity of color, in union with inequality of surface. In this way they sought to avoid the dullness, opacity and thinness which invariably accompany the use of paint, and are marked characteristics of European glass work. It was an American idea to make glass in lumps and chip it into flakes, to corrugate it, to blow it into shapes, or to pull molten glass out of shape. By such means the artist has succeeded in obtaining effects in this obstinate material which were deemed impossible. There was introduced a few years since the use of opalescent glass, the plating of glass over glass and developing the mosaic system, substituting it for glass painting. Churches, houses, hotels, and theatres are now decorated by the mosaic stained glass which is largely a product of New York studios. Upward of $3,000,000 was invested in 1902 in the stained glass industry in the United States.

Glasse, glas, **Hannah,** English writer. She was the author of ‹The Art of Cookery› (1747), a work whose claim to remembrance has depended chiefly on the mistaken reference to it of the proverbial "First catch your hare." In the fourth edition (1770) she is described as a habit-maker in Tavistock Street, Covent Garden.

Glauberite, glâ'bėr-īt, a mineral having the formula $Na_2SO_4.CaSO_4$, and crystallizing in the monoclinic system, usually in tabular forms. It is commonly pale yellow or gray in color, with a white streak. It has a hardness of from 2.5 to 3, and a specific gravity of from 2.7 to 2.85. Glauberite occurs in connection with rock salt in various parts of the world. In the United States is found at Borax Lake, San Bernardino County, Cal., and in tabular crystals in the Rio Verde Valley, Arizona.

Glauber's (glow'bėrz) **Salt,** sulphate of sodium, Na_2SO_4, so called from the German chemist, Glauber, who prepared it in 1658 by distillation of common salt with sulphuric acid, named it "sal mirabilis," identified it with the salt of a beneficial mineral water, and urged its good qualities. It occurs throughout Europe, especially at Carlsbad and Seidlitz, and in North America, notably at the Great Salt Lake in Utah. It forms oblique prisms which effloresce on the soil or on rocks. These are of a gray or yellow color, earthy, but transparent and vitreous when newly broken. It is readily soluble in water, and when heated or exposed to the air melts in its water of crystallization. Its chief use is in the manufacture of glass and sodium carbonate.

Glaucine, glâ'sĭn, an alkaloid contained in the leaves of *Glaucium flavum*, a sort of poppy. The leaves are macerated with acetic acid; the juice is pressed out, boiled, filtered and the filtrate is treated with lead nitrate, which precipitates lead fumarate. The filtrate is treated with H_2S, then the glaucine is precipitated with tannin, and the precipitate decomposed by chalk. Glaucine crystallizes out of water in small scales, is easily soluble in alcohol and ether, and forms crystalline salts.

Glaucodot, glâ'kō-dŏt, or **Glaucodote,** an orthorhombic, grayish, tin-white mineral of metallic lustre and black streak; hardness, 5; specific gravity, 6. Composition: Sulphur, 19.4; arsenic, 45.5; cobalt, 23.8; iron, 11.3. It occurs in chlorite slate in the province of Huasco in Chile, also in fine crystals in Sweden.

Glaucoma, glâ-kō'ma, a diseased condition of the eyeball characterized bv a retention of the fluids within its cavity. As the fluids accumulate, pressure is exerted on the delicate lining, with resulting injury or destruction of sight. It is due to any causes operating so as to close the place of exit for the fluids of the inner chamber of the eyes. See EYE, DISEASES OF.

Glau'conite, an amorphous green opaque mineral, like earthy chlorite, with a dull or glistening lustre. It is a hydrous silicate of iron and potassium, averaging: Silica, 49.3; alumina, 3.6; sesquioxide of iron, 22.7; protoxide of iron, 6.3; potash, 8.3, and water, 9.6. Its hardness is 2, and its specific gravity about 2.3. There are two varieties of it; the one the green earth of cavities in eruptive rocks, the other the green grains in greensand formation, or anything similar.

Glaucophane, glâ'ko-fān, a mineral of the amphibole group, crystallizing in the monoclinic system, and closely resembling amphibole in form. It is a silicate of aluminum, sodium, iron and magnesium, with variable proportions of the two latter metals. It is blue or gray in color, translucent with a vitreous lustre, and has a hardness of from 6 to 6.5, and a specific gravity of about 3.10. Glaucophane occurs in certain crystalline and mica schists, and is found associated with mica, garnet, epidote and dial-

lage. In the United States it occurs chiefly along the Coast Ranges of California.

Glaucus, glâ'kŭs, the name of several personages in Greek legend. (1) A sea-god, who was at first only a fisherman, and whose oracles were highly prized by fishermen, according to the legends. (2) The son of Hippolochus and grandson of Bellerophon. He assisted Priam in the Trojan war, and was foolish enough to exchange his golden armor for the iron suit of Diomed. He displayed much courage, but was killed by Ajax. (3) The son of Sisyphus, king of Corinth, by Merope, daughter of Atlas, and born in Potnia, Bœotia. He wished to make his mares swifter than others, for the purpose of vexing Venus, and Venus inspired the animals with such fury that they tore Glaucus to pieces as he returned from the games which had been celebrated by Adrastus in honor of his father. (4) The son of Minos II., and Pasiphæ, smothered in a cask of honey, and miraculously brought to life, by an herb sent by Polyidus the soothsayer.

Glaze (ceramic), a vitrified coating which gives to earthen-ware or porcelain its brilliance and impermeability.

Glazes are of three classes: the glaze proper (Fr. *couverte*), the soft glaze (Fr. *vernis*), and the enamel or opaque glaze (Fr. *émail*). The glaze proper is a silicate of calcium, potassium and aluminum, and is composed of feldspar, chalk or whiting, kaolin and quartz. It is applied either to the clay ware (Chinese) or to the soft burned biscuit (modern); the whole piece is then burned to a high temperature (about 1,500° C.). Soft glaze comprises the vast range of earthen-ware and faience glazes, and includes the glazes of bone china and soft porcelain. A soft glaze is either a silicate or a boro silicate, and the bases employed include the oxides and carbonates of the following elements: Lead, zinc, potassium, sodium, calcium, barium, magnesium, and as coloring agents the salts of iron, cobalt, copper, nickel, antimony, chromium and manganese.

The range of temperature is very wide. A simple lead glaze will fuse at 900° C. and a hard glaze for white earthen-ware may need 1,350° of heat. Enamels are sometimes used over other glazes and sometimes upon the biscuit body. Their essential condition is opacity. Oxide of tin, alumina, calcium phosphate and calcium carbonate are used as opacifiers. The early wares made in Italy, Spain and Holland were of this type (see MAJOLICA). For convenience of application glazes are ground in water and held in suspension, the article to be glazed being plunged into the liquid. For this reason only insoluble substances can be used, and where it is necessary to introduce alkaline salts and soluble boric acid or borates these are rendered insoluble by being melted with insoluble and readily combined reagents, such as whiting and barium carbonate. This melt is called a "frit" and the operation of melting is known as "fritting." Hence some glazes, mainly of the second class, are called fritted glazes, and glazes which contain no frit are termed "raw" glazes. Fritted glazes are, as a rule, harder and clearer than those which contain no frit except in the case of porcelain glaze (couverte), which is made from natural substances without frit.

Glaze'brook, Richard Tetley, English scientist: b. 18 Sept. 1854. He was educated at Cambridge and was principal of University College, Liverpool, 1898-9, and has been director of the National Physical Laboratory from 1899. He has published various scientific text-books; 'Laws and Properties of Matter'; 'Clerk-Maxwell and Modern Physics'; etc.

Glazier, glā'zhėr, **Willard**, American author: b. Fowler, N. Y., 22 Aug. 1841; d. 25 April 1905. His works include: 'Capture, Prison Pen, and Escape' (1865), which was very popular; 'Three Years in the Federal Cavalry' (1870); 'Battles for the Union'; 'Heroes of Three Wars'; 'Peculiarities of American Cities'; and 'Down the Great River.'

Glazier, Lake, Minn., a body of water south of Lake Itasca, into which it empties through a swift and permanent stream about 6 feet wide; named for Capt. Willard Glazier, who claimed for it a geographical importance as the true source of the Mississippi. Lake Glazier has an area of 255 acres. It is estimated to be 1,582 feet above the Atlantic, and 3,184 miles from the Gulf of Mexico.

Glea'son, Elliott Perry, American inventor: b. Westmoreland, N. H., 27 June 1821; d. New York 26 Sept. 1901. Received a common school education; was one of the first to manufacture gas burners; and invented the regulating argand burner and other lighting devices.

Gleason, Frederick Grant, American musician: b. Middletown, Conn., 17 Dec. 1848. He was a pupil of Dudley Buck at Hartford, Conn., studied also at Leipsic, Berlin, and London, became an organist at Hartford, and in 1876 removed to Chicago, where he was active as composer, teacher, and musical critic of the *Tribune*. Among his works are songs, trios, sonatas; the cantatas, 'Praise of Harmony,' 'God Our Deliverer,' and 'The Culprit Fay'; and the operas 'Montezuma' and 'Otho Visconti.'

Glebe, glēb (Lat. "soil," "clod"), the land possessed as part of the revenue of an ecclesiastical benefice in England or Scotland, often scattered through the parish. Where there are arable lands the glebe must consist of 4 acres; where there is none the parson is entitled to 16 soums of grass next adjacent to the church — a soum of land being as much as will pasture 10 sheep or 1 cow — so that the actual extent will vary with the richness of the soil. The glebe must be taken as near the manse as possible; and where there is no manse, vicinity to the church is the criterion. In general, the glebe is the subject of much discussion in the ecclesiastical law of both countries. Although the incumbent is temporarily proprietor, he has no right of alienating the glebe.

Glede, glēd, an old British name for a bird of prey, the kite. See KITE.

Glee, in music, a vocal composition in three or more parts, generally consisting of two or three contrasted movements, the subject of which may be either gay, tender, grave or pathetic. It is distinguished from a madrigal by its want of contrapuntal harmony, and in the independence of its parts it differs from a part-song. It is essentially English in origin

and cultivation, and the period during which its vogue was greatest and its form most perfect extended from 1760 to 1830.

Gleet, glēt, chronic urethritis; an obstinate inflammation of the urethra that follows acute gonorrhœa. The disease is evidenced by the continuation of the purulent discharge, or by a morning drop, or by the presence of shreds of mucous membrane appearing in the urine. It may be due to small ulcerated patches, the presence of a stricture, or inflammation continuing in the tiny pockets and glands. The cure of the inflammation requires astringent and antiseptic injections, usually some form of silver, and under some conditions the passage of steel sounds.

Glencoe, glĕn'kō, Minn., a village and county-seat of McLeod County, on the Chicago, M. & St. P. R.R. Stevens Seminary and St. Joseph's Academy are located here. Pop. (1900) 1,780.

Glendale, Battle of, also called **the Battle of Charles City Cross-roads, the Battle of Frazier's Farm,** and **the Battle of White Oak Swamp.** The battle of Gaines' Mill was fought on 27 June 1862. That night the Fifth corps and its supports crossed to the south side of the Chickahominy and destroyed the bridges, and the withdrawal of the Army of the Potomac to James River began. The battles of Allen's Farm and Savage Station were fought on the 29th, and on the morning of the 30th the Union army was across the White Oak Swamp Creek, covering the roads leading to James River and the immense trains on their way to Malvern Hill and Harrison's Landing. Franklin, on the right, with Smith's division of his own corps, Richardson's division of Sumner's, and Naglee's brigade of Keyes' corps, was at the bridge crossing of White Oak Swamp Creek. About two miles to the left, holding the intersection of the Charles City, Darbytown, and New Market roads, thus covering the Quaker road over which the trains must pass, was Sumner, with Sedgwick's division of his own corps. Heintzelman's two divisions of Hooker and Kearny, Slocum's division of Franklin's corps, and McCall's division. Slocum, on the right of Sumner's line, was on the Charles City road, about a mile in advance of the junction with the New Market and Quaker roads; Kearny was on Slocum's left between the Charles City and New Market roads; McCall was on Kearny's left, and Hooker to the left and rear of McCall; Sedgwick was in support to McCall, but during the forenoon, two of his brigades were sent to Franklin. Porter's and Keyes' corps were at or on the way to Malvern Hill. After making these dispositions McClellan left the field.

Gen. Lee's plan contemplated that Jackson should force a passage at the bridge held by Franklin, turn his right, and reach the Union rear; Holmes to attack and turn the Union left and prevent its reaching James River, while the divisions of Longstreet, A. P. Hill, and Huger, supported by Magruder, concentrating at the cross-roads, should cut McClellan's army in two and interrupt its retreat to the river. Early on the morning of the 30th Jackson advanced through Savage Station on Franklin, who opened upon him furiously with artillery and checked him. It was a great disappointment to Lee, and Jackson's want of enterprise on this occasion has been the subject of much criticism. Holmes advanced on the Confederate right with 6,000 men and 6 batteries, toward Malvern Hill, and was attacked by Warren's brigade of 1,50c men and 36 guns; the gunboats in the river opened upon him and he fell back in disorder, and called for help. Huger led the advance down the Charles City road; in an effort to determine the Union position and to protect his own flanks, his division became scattered, and he devoted the remainder of the day to reconnoitering and an almost harmless artillery duel with Slocum. While this division of 9,000 men frittered away the day, Longstreet and A. P. Hill were maintaining a furious contest.

Longstreet and A. P. Hill moved on the Darbytown road, Longstreet in advance, who, at noon, came upon McCall's pickets on the Frazier farm. Longstreet formed line and at 3 P.M. closely supported by A. P. Hill, attacked McCall, forced back his left brigade (Seymour's) after a hard struggle, and captured several guns. Hooker, with Grover's brigade, fell upon the flank of Longstreet's right brigade (Kemper's); Sumner's artillery, covering the opening between McCall and Hooker, opened fire, and Kemper was swept back just as Branch's and Pickett's brigades were advancing to his support, which in turn were checked, but kept up a stubborn fight until nightfall, when they were joined by Pender's and Archer's brigades of Hill's division, and held the ground from which Seymour had been driven. Wilcox's brigade, which had advanced on Pickett's left, captured Randol's and Cooper's batteries after a very obstinate fight, but was forced back by a counter-attack, and Cooper's battery was retaken. Field's brigade, coming to Wilcox's support, forced back Meade's brigade and captured some guns, but Meade rallied and drove it back. Farther on the Confederate left Pryor's and Featherston's brigades attacked Kearny's left and were several times repulsed. Slocum assisted Kearny with his New Jersey brigade, and Featherston's brigade being thrown into some disorder, Gregg's South Carolina brigade was sent to that part of the field. Late in the day Caldwell's brigade of Richardson's division moved from Franklin's position and reinforced Kearny's left. Two regiments only got into line and fired a volley; the engagement was about over, and darkness came with Kearny's line intact. Only one division, McCall's, had lost any ground during the day, and it lost its commander who was taken prisoner at the close of the engagement, and 14 guns. The Union troops had resisted three separate attacks on flank and rear, and under cover of their splendid fighting, involving great losses on both sides, the immense supply trains and the reserve artillery reached Malvern Hill at 4 o'clock in the afternoon. During the night the Union army fell back to Malvern Hill. Consult: 'Official Records,' Vol. XI.; 'McClellan's Own Story'; Webb, 'The Peninsula'; Allan, 'History of the Army of Northern Virginia'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. II.

E. A. CARMAN.

Glen'dive, Mont., a village and county-seat of Dawson County, on the Yellowstone River and on the Northern P. R.R. It is the centre

of a stock-raising and agricultural region and has railroad repair shops. Pop. (1900) 1,200.

Glens Falls, N. Y., village in Warren County; on the Hudson River, Glens Falls Feeder to Champlain Canal, and the Delaware & Hudson R.R. and Hudson Valley Trolley System (running from Warrensburg to Troy); about 56 miles north from Albany, 50 miles from Troy, 18 miles from Saratoga, and nine miles from Lake George. The river at this point has a descent of about 60 feet with a succession of falls and rapids. Cooper in 'The Last of the Mohicans' has celebrated the falls at this place and the famous cave which lies under the limestone formation at this point. This cave cannot be seen at high water in the spring and fall; at other times it is accessible to any tourist who wishes to visit this quasi-historical spot.

Industries.— Glens Falls is in an agricultural region; in the vicinity of the river are extensive limestone and black marble quarries which have been worked for more than half a century. At the falls, are located some of the largest, most extensive, and costly paper mills in the world, as well as various other manufactories. The chief manufactures of the city are paper, pulp, wall paper, Portland cement, lime, lumber, collars, cuffs, shirts, ladies' shirt waists, flour, laths, Joubert & White buckboards, lanterns, machinery and foundry products, ale brewing, brick (ordinary and artificial), paper boxes, cigars, confectionery, gold and silver refining, and various minor enterprises. Twelve miles above Glens Falls is situated the great Spier Falls dam across the Hudson, built by the Hudson River Water Power Company, supplying electric light and power along the Hudson and Mohawk valleys as far south as Albany and west to Utica. This power is second only to Niagara in importance in this country.

Public Works, Institutions, Buildings, Etc.— Glens Falls has several miles of paved streets, a paid fire department, police, and all modern municipal equipments. The village owns its own water works system. Glens Falls has an excellent union school system and its new high school building completed in 1906 cost over $120,000. It has also Saint Mary's and Glens Falls Academies, Crandall Free Library, Parks' Hospital, Glens Falls Hospital, Glens Falls Home for Aged Women, and the Crandall Park. There are many fine buildings including the home office building of the Glens Falls Insurance Company, the State Armory of Company K, 2d Reg., N. Y. M., the Ordway Memorial Y. M. C. A. Building, the Village Hall (costing $60,000), and the Empire Theatre Building. There are 11 churches comprising all the leading denominations. Glens Falls has three national banks and a trust company with a combined capital of $436,400 and deposits of $5,636,300.

History and Population.— Glens Falls is situated on the Great War Trail leading from Lake George to Albany. Just outside the village limits at the Half-Way Brook was located throughout the French and Indian Wars and the Revolutionary War a fortified post. A tablet was erected in 1905 by the New York State Historical Association commemorating the two massacres which occurred at that spot during this period, also the encampment there of General Riedesel with Burgoyne's forces while on their way to Saratoga. Glens Falls was settled in 1763; incorporated in 1837 and again in 1874 and 1887. In 1864 the village was practically destroyed by fire. In 1884 and also in 1902 it was visited by disastrous conflagrations entailing a loss of hundreds of thousands of dollars. Pop. (1900) 12,613; (1905) 14,650.

James A. Holden.

Glen'wood, Iowa, a city and county-seat of Mills County, 20 miles from Council Bluffs, on the Chicago, B. & Q. R.R. The State Institution for Feeble Minded Children is located here. The chief industries include fruit-growing, farming, and vegetable canning. It has a city hall, court house, and several churches. Pop. (1900) 3,040.

Gliddon, George Robbins, American archæologist: b. Devonshire, England, 1809; d. Panama, Colombia, 1857. He succeeded his father as United States consul at Alexandria, and was for a long time engaged in archæological researches in Egypt and the Levant. Later he came to the United States, and lectured in many cities on Oriental archæology, and was appointed agent for the Honduras Interoceanic Railroad Company. His principal works include: 'Appeal to the Antiquaries of Europe on the Destruction of the Monuments of Egypt' (1841); 'Discourses on Egyptian Archæology' (1841); 'Otia Ægyptica' (1849); 'Ancient Egypt'; 'Types of Mankind, or Ethnological Researches Based upon the Ancient Monuments, Paintings, Sculptures, and Crania of Races, etc.,' etc.

Glinka, glĕn'kä, **Mikhail Ivanovitch,** Russian composer: b. government of Smolensk 1 June 1803; d. Berlin 15 Feb. 1857. In 1836 his opera 'Life for the Tsar' was presented with great success at St. Petersburg. He was regarded as the founder of Russian national opera, and was appointed director of the imperial Opera and Kapellmeister to the Tsar. A second operatic work, 'Russlan and Ludmilla' (1842), was inferior. His orchestral arrangements of Russian dances became well known in foreign countries. He wrote (in Russian) 'Memoirs and Correspondence with Relatives and Friends' (1887). Consult the study by Fouqué (1880).

Glisan, glĭs'an, **Rodney,** American physician: b. Lingamore, Frederick County, Md., 29 Jan. 1827. He was graduated from the medical department of the University of Maryland (Baltimore) in 1849, was assistant surgeon, United States Army, in 1850–60, afterward practised medicine in Portland, Ore., and in 1881 was a delegate to the Seventh International Medical Congress. His writings include a 'Journal of Army Life' (1874).

Globe, a sphere, a round solid body, generated by the revolution of a semicircle about its diameter. Globe, or artificial globe, in geography and astronomy, is more particularly used of a sphere made of metal, plaster, or pasteboard, on the surface of which is drawn a map or representation of either the heavens or the earth, the former being called a terrestrial and the latter a celestial globe. The celestial globe is intended as a representation of the heavens, on which the stars are marked according to their several situations. The terrestrial globe is an artificial representation of the earth, ex-

hibiting its great divisions. The axis of the earth is an imaginary line passing through its centre, and the wire on which the artificial globe turns represents this line. The poles of the earth are the extremities of this axis. The brazen meridian is the circle in which the artificial globe turns, divided into 360 degrees. A degree of a great circle in the heavens is a space nearly equal to twice the apparent diameter of the sun, or to twice that of the moon when considerably elevated above the horizon. A degree on the equator of a terrestrial globe represents 60 geographical miles or 69.12 English miles.

Great circles, such as the equator, ecliptic, and the colures, divide the globe into two equal parts; small circles, as the tropics, polar circles, parallels of latitude, etc., divide the globe into two unequal parts. Meridians, or lines of longitude, are semicircles cutting the equator at right angles. In English maps and globes the first meridian is a great circle supposed to pass through the Royal Observatory at Greenwich. The equator, when referred to the heavens, is called the equinoctial, because when the sun appears in it the days and nights are equal all over the world. The declination of the sun, stars, and planets is counted from the equinoctial north and south. The ecliptic is a great circle in which the sun makes his apparent annual progress among the fixed stars; it is the real path of the earth around the sun. The zodiac on the celestial globe is a space which extends about 8° on either side of the ecliptic. Within this belt the motions of the planets are performed. The ecliptic and zodiac are divided into 12 equal parts called signs, each containing 30°; and the sun makes his apparent annual progress through the ecliptic at the rate of nearly a degree in a day. The colures are two great circles of the celestial sphere, one of which passes through the celestial poles and the equinoxes, and the other through the solstices and the celestial poles. The tropics are two smaller circles, each 23° 28′ from the equator, with which they are parallel; the northern is called the tropic of Cancer, the southern the tropic of Capricorn. The polar circles are two small circles parallel to the equinoctial, at the distance of 66° 32′ from it, and 23° 28′ from the poles.

Horizon when applied to the earth is either apparent or real. The sensible or visible horizon is the circle which bounds our view where the sky appears to touch the earth or sea. It extends only a few miles. The real or true horizon is an imaginary plane passing through the centre of the earth parallel to the sensible horizon. The wooden horizon circumscribing the artificial globe represents the true horizon on the earth; it is divided into several concentric circles arranged in the following order: one containing the 32 points of the compass divided into half and quarter points; another with the 12 signs of the zodiac, with the figure and character of each sign; and another having the days of the month answering to each degree of the sun's place in the ecliptic, and the 12 calendar months. The cardinal points of the ecliptic are the equinoctial and the solstitial points, which mark out the four seasons of the year.

The zenith is a point in the heavens exactly overhead and is the superior pole of our horizon. The nadir is a point in the heavens exactly under our feet, being the inferior pole of our horizon, and the zenith or superior pole of the horizon of our antipodes.

The pole of any circle is a point on the surface of the globe 90° distant from every part of the circle. Thus the poles of the world are 90° from every part of the equator; the poles of the ecliptic (on the celestial globe) are 90° from every part of the ecliptic, and 23° 28′ from the poles of the equinoctial. The equinoctial points are in the signs of Aries and Libra, where the ecliptic cuts the equinoctial. The vernal equinox is called the first point of Aries, and the autumnal the first point of Libra. When the sun is in either of these points the days and nights on every part of the globe are equal to each other. The solstitial points are in Cancer and Capricorn. When the sun enters Cancer it is the longest day to all the inhabitants north of the equator, and the shortest day to those on the south side. When the sun enters Capricorn it is the shortest day to those who live in north latitude, and the longest day to those who live in south latitude. The latitude of a place on the terrestrial globe, or its distance from the equator in degrees and minutes, or geographical miles, is reckoned on the brass meridian from the equator toward the pole. The quadrant of altitude is a thin piece of brass divided upward from 0 to 90°, downward from 0 to 18°; when used it is generally screwed to the brass meridian. The upper divisions determine the distances of places on the earth, the distances of the celestial bodies, their latitudes, etc.; and the lower divisions are applied to finding the beginning, the end, and duration of twilight. The longitude of a place on the terrestrial globe is the distance of the meridian of that place from the prime meridian, reckoned in degrees and parts of a degree, on the equator. Longitude is either east or west, according as a place is east or west of the prime meridian. No place can have more than 180°, or half the circumference of the globe. Hour circles are the same as meridians. The brass meridian and these circles always correspond.

Globe-fish, a plectognathous fish of the family *Tetraodontidæ*, examples of which are found on all the warmer coasts of the world, especially within the tropics. Ordinarily they are oval, spinose, small-finned fishes, which nibble the barnacles and crush the small crustaceans and mollusks near shore, with the rodent-like teeth which give them the name «rabbit-fishes» in the West Indies. The moment any danger threatens they suck air or water into a large bladder-like expansion of the abdomen and distend the scaleless skin until they are as round as a ball, all the spines are rigid, and they rise and float at the surface belly upward,— a difficult and disagreeable mouthful; this odd method of self-defense has given them the names «bellows-fish,» among English, and «tambor» among Spanish fishermen. Some tropical species are a foot or so in length, but those familiar as «puffers» or «swell-fish» along the coast of the eastern United States are much smaller and serviceable only as comical additions to an aquarium. The flesh of all is poor, and said to be poisonous. The two genera are Lagocephalus and Spheroides, the

latter containing the familiar northern puffers. Compare DIODON.

Globe Tavern, Battle of. On 17 Aug. 1864 Gen. Grant, then investing Petersburg, directed that Warren's Fifth corps and some cavalry be sent to destroy as much as possible of the Weldon Railroad and make such a demonstration on Lee's right as would force him to withdraw a portion of his troops from the Shenandoah valley, so that Sheridan might strike a blow at the rest of them. Warren was instructed to move at 4 o'clock on the morning of the 18th and make a lodgment upon the railroad two miles south of the Vaughan road, and destroy it as far south as possible. A brigade of cavalry under Col. Spear was attached to his command. Warren moved as directed, drove back Dearing's Confederate cavalry brigade, and took possession of the railroad at Globe Tavern, about three miles south of Petersburg. Griffin's division was formed along the road, and began its destruction. Ayres' division moved up the road a mile or more beyond Griffin, and Crawford moved up on Ayres' right. About 2 P.M. Gen. Heth, with two brigades, moved out of the Confederate works, made a sudden attack upon Ayres' left, and drove it back; Ayres rallied, and retook the lost ground. The Union loss was 544 killed and wounded, and 392 missing. On the morning of the 19th Bragg's brigade was sent to the right of Crawford to support him and establish connection by a skirmish-line with the Ninth corps, and Willcox's and White's divisions of the Ninth corps were ordered to Warren's support. The woods were so dense and the roads so intricate that Bragg failed to establish a proper line, and before it could be connected and completed it was broken. A. P. Hill with Heth's two brigades, Mahone's three brigades, Fitzhugh Lee's cavalry, and Pegram's batteries, moved to the Vaughan road intersection. At 4.30 P.M. Mahone in column of fours, broke through Bragg's skirmish-line, faced to the right, and sweeping forward dispersed Crawford's division and the right of Ayres'; at the same time Heth opened on Ayres' centre and left. Warren rallied the broken parts of his line and, advancing, regained the lost ground, taking some prisoners. Willcox's division engaged Colquitt's brigade, drove it back, and captured some prisoners; and Mahone's entire command fell back rapidly in great confusion to their entrenchments, "carrying with them the parts of Warren's command disorganized by the attack on their rear in the woods, and a large portion of the pickets." Heth made repeated attempts to drive Ayres back, but failed. Warren's casualties for the day were 382 killed and wounded, and 2,518 missing. On the 20th Warren selected a position on the railroad a mile or two in rear of his line of battle of the 19th, chiefly on open ground, and entrenched. On the morning of the 21st A. P. Hill, with his own corps, part of Hoke's division, with Lee's cavalry, attacked his position, opening with 30 guns on his front and right flank, and at 10 o'clock made an assault, which was repulsed. Later Mahone attempted an assault on Warren's left, but the artillery fire broke his ranks before they came under musketry fire, and Warren, making an advance, captured 517 officers and men and six flags. Warren's loss was 301 killed, wounded, and missing. No further attempts were made upon Warren's position, and the entrenchments were extended by the Ninth corps from the Jerusalem plank-road to unite with Warren's on the Weldon Railroad. The Union troops engaged on 21 August numbered about 20,000; the loss was 198 killed, 1,105 wounded, and 3,152 missing. The Confederates engaged numbered about 14,800; the number of their killed and wounded is estimated at 1,200. Consult: 'Official Records,' Vol. XLII.; Humphreys, 'The Virginia Campaign of 1864 and 1865'; Powell, 'The Fifth Army Corps'; Walker, 'The Second Army Corps.'

E. A. CARMAN.

Globe Theatre, the theatre in Southwark of which Shakespeare was a shareholder, and in which many of his plays were acted. The original theatre was built in 1593 on a tract of land between Maiden Lane (now New Park Street), and what was subsequently called Globe Alley; the site is now occupied by Barclay and Perkins Brewery. A patent was granted for this theatre by James I. in 1603. It was destroyed by fire in 1613 during the performance of Shakespeare's 'Henry the Eighth.' The accident was caused by the firing of the thatch roof, a cannon having been discharged during the performance, and the wadding shot from the stage pierced the roof. This was in 1613. The theatre was rebuilt the following year. In 1644 the structure was demolished to make room for dwelling houses. According to pictures and descriptions which have survived to the present day the old theatre must have been extremely dingy in the interior and uncomfortable both for the actors and spectators.

Globigerina, glŏb-ĭ-jĕ-rī'nă, one of the most common of the surface-living or pelagic Foraminifera (q.v.), a shelled protozoan of the class *Rhizopoda*. The animal is like an amœba, exceedingly simple, although throwing out a great number of long, slender thread-like pseudopods, with which it draws in and absorbs minute silicious plants, such as diatoms, etc., which serve as food. Though the animal is so simply organized, the limestone shell which it secretes is composed of several chambers, which are like their bubbles, hence the name of the commonest species, — *Globigerina bulloides*. It lives in countless numbers at the surface of the sea, floating on the top of the water, when the sea is calm, with its root-like arms or tentacles (pseudopodia) radiating from the body. The shell, which is of microscopic size, is perforated with fine openings through which the pseudopods pass out. After death the shells, when not dissolved, slowly fall or rain down to the bottom of the ocean, and so light and minute are they that it is calculated that it requires about a month for them to reach the bottom in the deeper parts of the ocean.

Globigerina Ooze.— The shells collect in such vast numbers on the floor of the ocean that a grain of the fine mud or ooze thus formed may contain nearly 50,000 of them. Chalk is formed of such foraminifers mingled with the debris of shells, corals, etc. Nummulitic limestone and greensand are mainly of foraminiferal origin. This ooze is a fine sticky mud-like sediment which covers the ocean bottom at great depths. Indeed, the ocean bottoms everywhere beyond the 100 to 500 fathom-line are free from any [illegible]

sediments. All this ooze is principally made up of the shells of this single species (*G. bulloides*) mentioned above. The more numerous these shells are at the surface, the greater is the depth at which they will accumulate at the bottom. There are only about 20 other species of these pelagic Foraminifera, yet as Murray states in his 'Report on the Scientific Results of the Voyage of H. M. S. Challenger,' so numerous are the individuals of the species that they usually make up over 90 per cent of the carbonate of lime present in the calcareous oozes of the abysses of the ocean. The remaining 10 per cent is mainly reddish clay. Great interest attaches to this subject because thick series of Tertiary and older rocks seem to have been formed out of similar oozes. Beside the globigerina oozes similar sticky deep-sea muds are formed of the shells of surface-living pteropods (q.v.), as also radiolarian oozes and diatom oozes, the latter confined to the Southern Ocean, a little to the north of the Antarctic Circle. The radiolarian ooze thus far has been detected only in the deepest abysses of the western and central Pacific. The red clay is derived by chemical changes from the globigerina ooze. See Deep-sea Exploration for information as to the method of ascertaining these facts.

Glob'ulins, a term applied to one of the forms of proteids (q.v.) of animal or vegetable origin. The animal globulins are proteids which are insoluble in water, soluble in dilute salt solution, and insoluble in saturated solutions of sodium chloride and magnesium sulphate. They are coagulated by heat, the temperature causing the coagulation varying considerably. Fibrinogen, serum globulin of blood, paramyosinogen and myosinogen, of muscle, and vitellin, found in eggs, are examples of animal globulins. The plant globulins constitute the most important and abundant natural proteids of plants.

Glo'ria in Excel'sis, the original and Latin form of 'Glory be to God on High,' the opening words of the dismissal hymn in the liturgy of the English Church as well as of the Protestant Episcopal Church in the United States. It is used in the Roman Catholic Church at all masses excepting those for the dead. These opening words are taken from the hymn sung by the angels at the Nativity. The origin of this half-inspired composition is lost in remote antiquity. It is found in the eastern Church as early as the days of Athanasius, but was used at evening service (nocturns), and not in the liturgy, or communion office. It has been attributed to Telesphorus, bishop of Rome, 150 A.D. Pope Symmachus, 500 A.D., is said to have ordered its use at the commencement of the Sunday and holy-day services. The hymn in full is as follows: "Glory be to God on high, peace on earth, to men of good will. We praise thee, we bless thee, we worship thee, we glorify thee, we give thanks to thee for thy great glory, O Lord God, heavenly King, God the Father Almighty. O Lord, the only begotten Son Jesus Christ; O Lord God, Lamb of God, Son of the Father, that takest away the sins of the world, have mercy upon us. Thou that takest away the sins of the world have mercy upon us. Thou that takest away the sins of the world, receive our prayer. Thou that sittest at the right hand of God the Father, have mercy upon us. For thou only art holy; thou only art the Lord; thou only, O Christ, with the Holy Ghost, art most high in the glory of God the Father. Amen."

Gloria Pat'ri, the first words in their original Latin of the doxology sung or said in the services of the Roman Catholic Church, the English Church, and the Protestant Episcopal Church in the United States, and other religious bodies. It is employed as a refrain at the end of psalms and canticles as well as at other parts of the service. The complete form of the doxology is as follows: "Glory be to the Father, and to the Son, and to the Holy Ghost. As it was in the beginning, is now, and ever shall be, world without end. Amen." The doxology is common at the beginning of service in the Greek Church, and was employed at nocturns in the Western or Roman Catholic Church as early as the 6th century.

Gloss (Gr. "tongue"), the explanation of verbal difficulties in a literary work, written at the passages to which they refer. The words which are commonly the subject of these explanations are those taken without modification from a foreign language, provincialisms, obsolete and technical words, or such as are used by the author in some exceptional signification. The earliest glosses, as those in Greek, Latin, and Hebrew manuscripts, were interlinear; they were afterward placed in the margin, and extended finally in some instances to a sort of running commentary on an entire book. In Roman law the word is used also of an explanation, but the explanation is not merely of a word, but deals with the intent of the law. The glosses on the Justinian code, collected by Accursius in the first half of the 13th century, were held almost as high authority as the code.

Glossitis, glŏs-sī'tĭs. Acute glossitis is an uncommon disease of the tongue due to bites, burns, and stings. It starts in the deeper structure of the tongue, causing it to swell rapidly. The affection is very painful, but is ordinarily cured, if properly treated, in five or six days. Small or large incisions may be necessary. Chronic glossitis is a condition of the tongue, due to persistent use of tobacco, alcohol, and spices, in which the surface is reddened, cracked, and furrowed.

Glot'tis, the upper end, including the opening of the windpipe, which latter constitutes a narrow aperture covered by the epiglottis during the act of holding the breath or swallowing. The glottis contributes by dilatation and contraction to the modulation of the voice. It is sometimes called the rima glottis, a term more properly limited to the opening of the windpipe. See Larynx.

Glottis, Œdema of the, a dangerous affection characterized by the effusion of serum in the tissues of the entrance and the inside of the larynx, causing an obstructive swelling. It is due to burns, scalds, and the lodgment of foreign bodies; to acute laryngitis or tonsilitis; to tuberculous and cancerous deposits; and to nephritis, measles, diphtheria, scarlet fever, and erysipelas. The symptoms which usually develop rapidly are pain, cough, loss of voice, and great difficulty of breathing. This difficulty of breathing, unless relieved, may go on to complete suffocation. Incision of the parts may

give relief, or tracheotomy or intubation may have to be performed. See NOSE AND THROAT.

Gloucester, Mass., a city and port of entry of Essex County, near the extremity of Cape Ann, and on the Boston & Maine R.R.; 32 miles northeast of Boston. It is one of the most important fishing ports and fish markets in the world, having over 500 vessels and 6,000 men engaged in the fisheries. Cod, haddock, halibut, herring, and mackerel are the principal catches. Besides extensive fisheries, the city has large manufactures of machinery, oil, fish-glue, shoes, twine, and cigars. Numerous vessels have been wrecked in the vicinity of Gloucester. A massive rock called Norman's Woe was the inspiration for Longfellow's famous poem, 'The Wreck of the Hesperus.' The city was founded in 1623, principally by settlers from Gloucester, England, from which it received its name; was incorporated as a town in 1642; and became a city in 1874. The city is governed by a mayor, elected annually, and by a bicameral council. The waterworks are operated by the city. It has the oldest Universalist church in the United States, founded in 1770. Pop. (1900) 26,121.

Gloucester City, N. J., a city in Camden County, on the Delaware River and on the Atlantic City and the West J. and Seashore R.R.'s. The manufactures include calico prints, woolen yarns, gas burners, and boats. The city was incorporated in 1868, and is governed by a mayor chosen every two years, and by a unicameral council. It has ferry connections with Philadelphia, and has electric lights and street railroads. Pop. (1900) 6,840.

Glove, an article of dress; a covering for the hand. Its use reaches back to remote antiquity. Laertes, the farmer-king, wore gloves to protect his hands from the thorns. Xenophon sneers at the Persians for wearing gloves to keep their hands warm. In their more robust days the Greeks and Romans scorned the use of gloves; but in later times they were used in Rome. The glove appears to have become a well-known article of dress in England about the 14th century, and corporations of glovers were in existence in the 15th century. In the days of Queen Elizabeth gloves were made with gauntlets upon which much rich and elaborate embroidery was worked.

Modern gloves are of two distinct classes, woven and knitted gloves, and those made of leather: and the making of these constitute entirely separate branches of manufacture. The manufacture of knitted or woven gloves is an industry allied to the hosiery trade, and the materials comprise all the ordinary fibres, the most important being silk and wool. In some cases these gloves are entirely made and finished by knitting; but in others, the pieces are separately fashioned and sewed together as in making leather gloves. The manufacture is widespread, but the headquarters of the thread and cloth glove trade are now Berlin and Saxony. The materials used for making leather gloves are principally the skin of deer, sheep, and lambs, goats and kids, the latter being the most important, though far more "kid" gloves are made of sheep than of kid leather. The skins for military and other heavy gloves — doe or buck leather — are prepared by the ordinary process of tanning, or are a fine kind of chamois leather. Those for what are called dressed kid gloves are subjected to a special method of tanning, by which, under the influence of heat, and treatment with a mixture of flour, yellow of egg, and alum, the material is rendered peculiarly soft and flexible. After the leather has been properly prepared it is cut into pieces of the required size, then folded over somewhat unequally, as the back should be larger than the front. Three cuts are then made through the doubled piece to produce the four fingers; an oblong hole is cut at the bending of the fold for the insertion of the thumb piece; the cutting of this of the exact shape and size requires considerable skill. The first and fourth fingers are completed by gussets or strips sewed only on their inner sides, while the second and third fingers require gussets on each side to complete them. Besides these, small pieces of a diamond shape are sewed in at the base of the fingers toward the palm of the hand.

A kind of vice or clamp, with minute teeth to regulate the stitches, is used in the making of hand-sewn gloves, by which method all the finest gloves are stitched. Sewing-machines are applied for the ornamental or embroidery stitching on the backs of fine gloves, and for almost the entire sewing of the cheaper and heavier gloves. The superiority of the French and the best English gloves depends chiefly on the adaptation of their shape to the structure of the hand by giving additional size where the flexure of the hand requires it.

Kid gloves are of two principal kinds, glacé and suède, according to the manner of dressing and finishing the leather used. Glacé gloves are those which are dressed, dyed, and polished on the hair or outer side of the skin, while suède gloves are carefully pared, smoothed, and dyed on the inner side of the skin for their purpose, and thus have the appearance of fine chamois. Paris and Grenoble are the chief seats of the French kid glove trade. Military gloves are made at Niort and Vendôme. Brussels and Copenhagen are also important glove-making centres. In England, Worcester is the principal seat of the glove industry; and in a specialty, the so-called English dogskin gloves made from tan skins of Cape sheep, the English manufacturers are without rivals. Rubber gloves are now made in both Europe and America and are largely used in operations demanding careful asepsis, particularly when the surgeon is forced to operate on a clean case after a septic wound. Gloves with roughened surfaces are made to facilitate the handling of instruments and ligatures. See GLOVE MANUFACTURE IN AMERICA.

Glove Manufacture, in America, dates from about the year 1760, when Sir William Johnson, chief agent of King George with the North American Indians, brought over from Scotland several families from Perthshire, which settled in the eastern part of what is now Fulton County, N. Y., calling the town Perth. Many of these settlers had been glove-makers and members of the glove guild in Scotland, and brought with them glove patterns and the proper needles and threads for glove making. The first gloves and mittens were used chiefly by the farmers and wood choppers as a protection for the hands while engaged in the rough and la-

borious work incident to their occupation. The entire output of the industry for many years was probably disposed of in the immediate vicinity. It was not until about 1809 that gloves were manufactured for more distant markets, and it is stated that Talmadge Edwards, a storekeeper of Johnstown, N. Y., was the pioneer in the manufacture of gloves in commercial quantities. Mr. Edwards took a bag of them on horseback to Albany when making a trip for the purpose of renewing his stock of merchandise. Finding a good demand for these articles, he had leather dressed in quantities, and secured farmers' girls to come to his factory to cut gloves, which were then sent out to farmers' wives to be sewed. In this manner the glove and mitten industry of the United States was established. During the incipient stages of this industry the goods produced were really mittens, and not gloves. A glove, as distinguished from a mitten, is a covering for the hand in which each finger is separately enclosed, the part above the hand varying in length according to fashion or convenience. About the year 1810 a glove manufacturer, who had been associated with Mr. Edwards, sold a part of his output by the dozen, and this is said to be the first instance in which they were sold by the quantity. The local demand continued to increase, and each year some enterprising manufacturer would venture to make an extended trip to dispose of his product. In 1825 Elisha Johnson, of Gloversville, N. Y., went to Boston with a load of gloves in a lumber wagon, making the journey in six weeks. This is said to have been the longest trip that had been made in connection with the industry up to that time, and the results were highly gratifying to those interested.

Until 1862 the manufacture of gloves in Fulton County, N. Y., although even then the chief manufacturing industry, was of comparatively small importance. The stimulating influence of a high protective tariff in 1862 showed itself in the increased business at Gloversville, Johnstown, and the adjoining village of Kingsborough, which became at once the leading sources of supply for the home market of gloves of medium grade. While the protective tariff stimulated home industry in one direction, it limited it in another. The domestic materials that could be used in glove making were confined practically to deer, lamb, and sheep skins. The peculiar qualities of the first established it firmly and independently of any tariff, but the others being inferior in quality to skins of foreign production, could not effectually exclude foreign made gloves, but were forced to share the market with them. Still, the demand for cheap and medium gloves was limited, and the American manufacturers saw their development arrested, while France, Germany, and England continued to supply all the finer grade of gloves used in this country. In 1872 the tariff on imported skins was removed amid intense opposition and doleful prediction of ruin to the home industry. A large number of skins came from all parts of the world, and the glovers turned their attention to tanning. Instantly experimenting began, and skill in tanning rapidly increased, so that the highest grade was attained, and to-day the various kinds of leather produced in Fulton County are unsurpassed in quality by that furnished in any other part of the world.

The introduction of free hides made American glove manufacturers far more prosperous than they had ever been previously. The quality of the product has steadily improved, and the variety has been increased until now American made gloves are steadily driving out the foreign gloves. The skill of American glovers is equal to that of foreign glove-makers, and in some respects — notably in the quality and style of the stitching, and in some grades, the shape — the American gloves are the best. The American glovers are more enterprising, and their styles are of a greater and better variety than foreign made gloves. Foreign expert workmen have been drawn over here from the great glove centres in Europe, so that the greatest skill has been secured here. The approximate value of the glove industry in Fulton County has reached about $10,000,000. Some of the firms do a business reaching as high as $1,000,000, but the majority, however, have small shops and do a small but profitable business.

Most of the work in Fulton County, as abroad, is done at the homes of the workers. The streets in Gloversville and Johnstown are lined with pretty and tasteful homes, in which the hum of the sewing-machine is constantly heard during the working hours of the day, but the workers are exceptionally fortunate in being able while earning good wages to enjoy all the comforts and surroundings of home, and in being practically their own masters and mistresses.

When the skins are received at the factory they are thoroughly soaked to open out the texture and prepare them for the removal of the hair. Then the skins are placed in vats of lime water, where for two or three weeks the lime works into the flesh and albuminous matter, and loosens the hair. The skins having thus been properly softened, the dirty but picturesque operation of removing the hair ensues. Before each beamer, as the workman is called, is an inclined semi-cylindrical slab of wood, covered with zinc. The skin is first spread upon this, and the broad curved beam of the knife glides across it from end to end, scraping and removing all the loosened hair, the scarf skin, and the small portion of animal matter still adhering to the skin. After unhairing, kid skins must be fermented in a drench of bran, whose purpose is to completely decompose the remaining albuminous matter, and also to remove all traces of the lime. The operation is extremely delicate.

With the preparation of kid leather, alum is the astringent curative agent. Its operation is accompanied by that of others, whose purpose is to secure elasticity, and pliability, and mainly to preserve that beautiful texture which makes kid leather superior to all others. These assistants in the process are eggs, flour, and salt. They are combined into what is called a custard, and there is certainly nothing repulsive in the idea of such a delicate agent being used. A proper quantity of the custard and a number of skins having been put together in a dash-wheel, where they are thrown about for some time, opens the pores of the skin, absorbs the custard freely, and becomes swelled by the chemical union of the custard and the skin. This having progressed satisfactorily, the skins are folded together with the fleshy side outward, and are dried by a gentle heat. They are now cured, but they are yet hard and rough. The breaking and «staking,» as they are called, are now resorted

to, to make the skins soft, pliable, and of even texture, removing the superfluous chemicals with which they have become charged, and the stiffness by manipulating the fibres. The operation of transforming the skin into leather is now finished, but age is necessary to secure perfect pliability and softness. The skins are therefore laid away to let the slow chemical operation going on within them be completed. After this has been accomplished the skins are ready for dyeing, cutting, and manufacturing.

Calf skins as well as horsehides are used in the manufacture of workingmen's gloves. They are tanned in two ways, namely, oil tan, with a preparation that makes them what is called "fire and water proof," and they are also dressed and have the same finish as the buck glove.

In the dye-rooms the skins which have already been aged are immersed in dye vats, where the delicate colors are imparted to them. The same care is not required in obtaining the ordinary range of dark colors, for these are "brushed" on, the skin being spread upon a glass slab and the dye being painted on with a brush. After they are dyed the skins are sometimes somewhat hard, and some classes have to be staked again in order to restore their pliability. The finishing touches to a kid skin are secured by rubbing the grain side over with a "stick," which imparts a gloss. The experience of Gloversville manufacturers with buck gloves has enabled them to impart a special finish to a skin the same as the suède finish, which is very popular under the title of "mocha." This is the same as suède finish, which is produced in other countries, by shaving off the grain side of the skin at an early stage of its progress. The Gloversville method is much better, however, and has more perfect results. Here the grain is removed, and the velvet finish secured by buffing the surface on an emery wheel. The surface of the leather is cut away in minute particles by this process, and the result is an exceedingly even and velvety texture, superior to that obtained by other methods.

The concluding work is as follows: A marble slab lies before the cutter on a table, and every particle of dirt or other inequality is removed before "doling." The skin is spread, flesh side up, upon the slab, and the cutter goes over it with a broad-bladed chisel or knife, shaving down inequalities and removing all the fibrous portions. The dexterity with which this is done makes the operation appear extremely simple, but any but a skilled and experienced operative would almost surely cut through the skin. The most delicate part of the glove-maker's art, in which exact judgment is required, comes in preparing the "tranks" or slips from which the separate gloves are cut. The trank must be so cut as to have just enough leather to make a glove of a certain size and pattern. The operation would be easy enough if the material were hard and stiff, and if the elasticity were uniform, but this is rarely the case.

The gussets, facings, etc., are cut from the waste leather in the thumb opening at the same operation. In olden times an outline was traced upon the leather and the pattern was cut with shears. Modern invention has produced dies and presses, which are universally used. Similar dies are used in the cutting of the thumb pieces and forchettes or strips forming the sides of the fingers.

The gloves are somewhat unsightly as they come from the sewer's hands, and must be made trim and neat. To secure these desirable results the gloves are taken to the "laying-off" room. In this are long tables with a long row of brass hands projecting at an acute angle. These are filled with steam and are too hot to touch, but by ingenious devices they are so arranged that it is impossible to burn the glove or stiffen the leather by too much heat, a common defect in ordinary methods. The operation of the "laying-off room" is finished with surprising quickness. Before each table stands an operator, who slips a glove over each form, draws it down to shape, and after a moment's exposure to the warmth, removes it, smooth, shapely, and ready for the box.

About 25 years ago a skin called "mocha" was utilized, and has been ever since, in making fine gloves, and they are finished similar to the suède finish, giving them a very velvety appearance. They are very soft and pliable, and in fact have been almost as popular as the fine kid and lamb gloves. These mocha skins are all gathered in Arabia.

In 1900 Fulton County, N. Y., produced gloves to the value of $[illegible], as against $[illegible], the total value of the output in the United States. Fulton County had 166 out of the 381 factories in the United States and 7,981 wage-earners, as against 14,180, the total number in the United States.

COMPARATIVE SUMMARY OF THE GLOVE TRADE IN THE UNITED STATES FROM 1850 TO 1900.

	1900	1890	1880	1870	1860	1850
Number of establishments	397	[illegible]	300	[illegible]	[illegible]	110
Capital	$[illegible]	$5,97[illegible]	$[illegible]	$[illegible]	$594,825	$[illegible]
Wage earners, average number	14,436	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total wages	$[illegible]	$[illegible]	$1,655,695	$[illegible]	$[illegible]	$[illegible]
Cost of materials used	$9,554,105	$5,021,144	$4,351,469	$[illegible]	$[illegible]	$[illegible]
Value of products, including custom work and repairing	$[illegible]8,656	$10,103,821	$[illegible]	$3,998,521	$[illegible]	$708,184

The imports of gloves from all countries amounted to $[illegible] in 1900, of which we received $[illegible] from France and $[illegible]5,103 from Germany.

BENJ. LICHTENBERG,
Of J. Adler & Company, New York.

Glove or **Finger Sponge**, a poor variety of commercial sponge found about the Bermudas and in the Gulf of Mexico, which has a branching growth likened to the fingers of a hand or glove.

Glover, Elizabeth. See BENNETT, MARY E

Glover, John, American soldier: b. Salem, Mass., 1732; d. Marblehead, Mass., 1797. A shoemaker, and later a fisher at Marblehead, he was elected (1773) colonel of a militia regiment, known in the Revolution as the Fourteenth, or the "Marine" regiment. In 1775 he, with Stephen Moylan, was appointed director of the manning and equipment of vessels, in 1776 after the Continental defeat at Long Island superintended the transportation of the army to New York, and also directed the crossing of the Delaware previous to the battle of Trenton. Commissioned brigadier-general in 1777, he participated in Sullivan's Rhode Island expedition (1778), was a member of the court that tried André, and was retired in 1782. He sat in the Massachusetts convention that ratified the Constitution in 1788. A bronze statue of Glover stands in Commonwealth Avenue, Boston.

Glover, Richard, English poet: b. London 1712; d. there 25 Nov. 1785. In 1737 he published the epic poem of 'Leonidas,' which abounds in noble sentiments, considerably varied by incident and description; but wants interest, and is not sufficiently imaginative for lasting popularity. The 'Progress of Commerce' followed in 1739; one of the objects of which was to rouse a spirit of national hostility against the Spaniards and the ministry — a purpose which was much more effectually answered by his celebrated ballad of 'Hosier's Ghost.' In 1753 his tragedy of 'Boadicea' was performed with partial success. His 'Medea,' imitated from Euripides and Seneca, in 1761, obtained greater attention.

Glover, Stephen, English composer: b. London 1812; d. Bayswater, London, 7 Dec. 1870. He wrote nearly 1,500 compositions, including works for pianoforte, vocal duets, ballads, and songs, many of a sacred character, such as the 12 'Songs from the Holy Scriptures.' Among his published music are: 'The Monks of Old'; 'The Gypsy Countess'; 'What are the Wild Waves Saying?' and a setting for Longfellow's 'Excelsior.'

Glover, William Havard, English composer: b. Kilburn, London, 6 June 1819: d. New York 28 Oct. 1875. For several years he was musical critic of the London *Morning Post,* and in 1868 became conductor of Niblo's orchestra and a teacher in New York. His writings include the opera 'Ruy Blas' (Covent Garden 1861); a cantata, 'Tam o' Shanter,' first presented at the New Philharmonic in 1855 with Berlioz as conductor; and the overtures 'Manfred' and 'Comala.'

Gloversville, N. Y., city in Fulton County, on the Fonda, J. & G. R.R., 53 miles northwest of Albany. This is the most celebrated glove manufacturing centre in the world, producing over two thirds of the entire glove output of the United States. Here are the Nathan Littauer Hospital, the Parsons Free Library and other public institutions. Besides numerous large manufactories for gloves, gauntlets, and mittens, there are other factories of leather goods. It was incorporated as a village in 1851, although it was settled before the Revolution, being known as Stump City. It was chartered as a city in 1890. The municipal government under the revised charter of 1899 is administered by a mayor, who is elected by the people every two years, and a common council, elected for a like period. The members of the board of education and the water commissioners are also chosen by popular vote. The municipality owns and operates the water-works. Pop. (1900) 18,350.

Glow-worm. See FIRE-FLY.

Gloxinia, glŏk-sĭn'ĭ-a, a small genus of plants of the *Gesneraceæ,* distinguished by the somewhat bell-shaped corolla, the upper lip being shortest and two-lobed, the lower three-lobed, with the middle lobe largest, and also by the summit of the style being rounded and hollowed. The species are natives of tropical South America. They are now among the greatest ornaments of hothouses, owing to their handsome leaves and their graceful, beautifully colored flowers. The chief species is *G.* (*Ligeria*) *speciosa,* a Brazilian plant with large violet flowers, from which many fine varieties have been derived, usually associated under the specific name *G. hybrida.* Some species of *Sinningia* are also called gloxinias.

Glucic, gloo'sĭk, or **Glycic Acid,** an organic acid obtained from glucose or other compounds of a similar nature. When a solution of glucose is saturated with lime and allowed to stand for some weeks, the glucose is gradually decomposed, entering into combination with the lime to form a new substance known as glucate of calcium. By the addition of subacetate of lead, a bulky precipitate of glucate of lead is thrown down, and from this the free glucic acid may be prepared by separating the lead in the form of sulphid, by the action of sulphuretted hydrogen gas. Thus prepared, glucic acid is a colorless, amorphous mass, very soluble in water and in alcohol, and having an acid taste. The salts of glucic acid are mostly soluble in water, the sodium and barium salts being very hygroscopic. The formula of the acid is probably $C_{12}H_{22}O_{12}$.

Glucina, the oxid of glucinum (q.v.).

Glucinum, gloo-sī'nŭm, or **Beryllium,** a metallic element which occurs in the minerals beryl, chrysoberyl, phenacite, and euclase. The name "beryllium" was assigned to it on account of its occurrence in the beryl, and the name "glucinum" on account of the sweetish taste of its salts. Its chemical symbol is sometimes taken as Be, and sometimes as Gl. Glucinum is a dyad, with an atomic weight of about 9.08, and a specific gravity (when compressed) of about 1.85. It resembles steel in general appearance, and forms hard, hexagonal crystals which are unaffected by air at ordinary temperatures, and which are scarcely affected by oxygen or sulphur, even at a red heat, though when heated in chlorine the metal burns to the chlorid, $GlCl_2$. It dissolves readily in hydrochloric acid. Sulphuric acid and caustic potash or soda also dissolve it, but nitric acid, even when hot, and concentrated, acts upon it very slowly. The specific heat of metallic glucinum is about 0.400 at ordinary temperatures, but it increases rapidly as the temperature rises, and is about 0.58 at 500° F. The oxide of the metal, known as "glucina," GlO, was first ascertained to be a new earth by Vauquelin, who in 1798 obtained it from beryl, and pointed out that it differs from alumina in several important ways, notably in the fact that it does not form an alum. Metallic glucinum was first prepared by Wöhler

in 1828, by the action of metallic potassium upon fused $BeCl_2$. Glucinum forms many salts, but the metal and its compounds are of interest only to the chemist, as they are not used for any purpose in ordinary life.

Gluck, glook, **Christoph Willibald**, Ritter von, German composer: b. Weidenwang, Bavaria, 2 July 1714; d. Vienna 15 Nov. 1787. After studying six years at the Jesuit school at Komotow, where his musical talents were especially encouraged, he supported himself for a time by giving music lessons. Later he attracted the notice of Prince Lobkowitz, who enabled him to complete his musical education at Vienna. At 26 he was desired to write an opera for the court theatre at Milan and the result was his 'Artaserse,' which achieved a great success in spite of many innovations in composition introduced into the work. In 1742 he wrote: 'Demofoonte' for Milan; 'Demetrio ed Ipermnestra' for Venice; in 1743 'Artamene' for Cremona, and 'Siface' for Milan; in 1744 'Fedra' for the same theatre; and in 1745 'Allessandro nell' Indie' for Turin. His fame had now become European and he went to England to compose for the theatre in the Haymarket. On 7 Jan. 1746 that theatre was opened with 'La Caduta de' Giganti.' In London Gluck became deeply impressed with the majestic character of Handel's airs and choruses, and with the simple but natural dramatic style of Arne. Leaving London in 1746 he continued opera composition, among his later works being: 'Clemenza di Tito'; 'Le Cinese'; 'Il Trionfo di Camillo'; 'Antigone'; 'La Danza'; and 'Orfeo ed Euridice' (1762), his greatest work up to that time, and still a favorite in Germany after nearly a century and a half. It was followed by 'Alceste' (1766); and 'Paride ed Elena' (1769). In 1774 his 'Iphigénie en Aulide' was produced in Paris after a considerable amount of opposition from the musical critics of the old Italian and French school, at that time represented in Paris by Piccini. The most intense excitement prevailed; all Paris took sides, and for a long time the Gluckists and Piccinists contended with the same bitterness as did formerly the Jansenists and Jesuits, and in our own day Wagner and his opponents. The victory remained with the Gluckists. Shortly after the production of the 'Iphigénie,' the 'Orfeo' was adapted for and put on the French stage, and was followed by the 'Armide' in 1777, and by the 'Iphigenie en Tauride' in 1779, his last important work, and by many considered his greatest. It ends the series of works which directed the operatic genius of Méhul and Cherubini in France, and of Mozart, Beethoven, and Wagner in Germany. See 'Lives' by Marx (1863), Desnoiresterres (1872), Reissmann (1882).

Glu'cosan, or **Dextrosan**, $C_6H_{10}O_5$, a substance formed by heating anhydrous glucose to 340° F.; the anhydrous glucose that is required for the purpose being prepared by crystallizing ordinary glucose from its solution in 95 per cent alcohol. Glucosan is a colorless substance with a faint sweet taste. It is soluble in water and in alcohol, and is not fermentable by yeast. By the action of dilute mineral acids it is reconverted into glucose; and when heated for some time to 400° F. it turns to a brownish black color, and passes into caramel (q.v.).

Glucose, gloo'kōs (from Gr. γλυκυς sweet), a liquid substance obtained from corn, sometimes called "cereal syrup"; when in solid state, known as grape-sugar or "cereal sugar." In Europe it is chiefly made from potato starch. Men noted nature's process of changing the starch stored in the cells of plants into different forms of sugar. In the case of cane-sugar (sucrose) they knew that the plant absorbs carbonic acid from the air; other acids from the soil; and by the aid of the sun's heat a chemical process is evolved that puts into the sugar-plant sucrose or cane-sugar, and into fruits and vegetables fruit-sugar which is found more plentifully in the grape than in any other fruit.

The chemist seeks to obtain sugar from starch by a somewhat analogous process, and one similar to that carried on in the human system during the process of digestion, when starch is changed into sugar. Cane-sugar and fruit-sugar as they exist in cane and fruits are natural products, but whether nature's order of combining the various articles composing fruit-sugar as found in fruits is the same as the order of combination followed by the chemist in making sugar from starch is a puzzling and debatable question. Some claim that while the glucose of fruits and glucose as obtained by the chemist may be identical so far as their constituent elements are concerned and the proportion of each which is present, it does not follow that they are the same thing, or that their dietetic value is as great. Neither does it follow that because the chemical composition of glucose (dextrose) is almost identical with that of cane-sugar (sucrose) its food value is quite as evenly matched.

Theory and Fact on Sugar.— A committee of experts of the National Academy of Sciences, reporting to the United States government in 1884 on glucose said: "Starch-sugar is in no way inferior to cane-sugar in healthfulness"; in answer to which a dealer asked: "How is it then that I can feed a hog on cane-sugar and make him fat; but if I should feed him on glucose he would not put on an ounce of fat as long as he lives?" Here theory ran against fact, and to this day there is a conflict over the question which will not be settled until the physiologist has made elaborate studies of the effect of glucose on the human system, a task almost impracticable, because the chemical condition of each individual stomach is an unknown quantity, and because each person is a law unto himself in the use made of food.

Nature and Chemist.—In the laboratory of nature the starch or gum ($C_6H_{10}O_5$) which is formed in the plant is treated by carbonic acid taken from the air, and by other acids absorbed from the soil and carried into the plant by the sap, and through the action of light and heat is changed into cane-sugar (sucrose) $C_{12}H_{22}O_{11}$.

Art or chemistry takes starch from corn (maize), treats it with hydrochloric or other acid, which is neutralized or removed by alkali, the resultant product being glucose $C_6H_{12}O_6$, differing in its constituent elements from cane-sugar in that it contains one more equivalent of water. If to $C_{12}H_{22}O_{11}$ (cane-sugar) is added H_2O, it is equal to twice $C_6H_{12}O_6$ or glucose $C_{12}H_{24}O_{12}$. "It remains," said a prominent manufacturer of glucose, "for some one to discover means for eliminating from glucose the one equivalent of water; and, that found, chemistry

can make from starch an article the chemical formula for which is exactly like cane-sugar. And somebody will some day stumble over the method."

History of Glucose.— It was in 1792 that Lowitz announced that there was other than cane-sugar, he having obtained dextrose, a different variety, from grapes. In 1811 dextrose was obtained from starch by the action thereon of dilute sulphuric acid. By similar process Braconnot, in 1819, obtained it from linen rags, sawdust, or other vegetable fibre. During the reign of Napoleon Bonaparte starch-sugar was made to make good the deficiency which the continental blockade caused in the supply of cane-sugar. Early in the 19th century it was made from potato-starch in Germany, and during the latter half in France. From 1825 to the present time the chemists of France, Germany, and the United States have studied to improve processes, but nowhere in the world is glucose made so perfectly and at so low a cost as in the United States, where raw material is cheap, and the processes of manufacture so perfected that this country is fast meeting the European demand for glucose and causing the industry to dwindle in continental Europe. This country can manufacture glucose, send it to Europe, pay a 30 per cent tariff, and then undersell the makers of Europe, the proof of which is the statement which follows showing the exports of glucose from the United States. From 1838 the number of factories in France and Germany increased until 40 years later there were 85, and in the Austrian empire, where the industry began about 1840 or a few years earlier, over 100. In 1889 Germany had 30 glucose factories which produced 34,684,100 kilos glucose syrup; 2,748,000 kilos couleur.

The manufacture of glucose or grape-sugar from starch has been a prominent American industry for about 30 years. In March 1865 Dr. Goesling made glucose under a patent he had procured. The sample exhibited led to the formation of a stock company which purchased of Goesling, Bradley & Briggs their patent for manufacturing sugar and syrup from Indian corn. The company began the manufacture of glucose in the old sugar-refinery in Rose Street, New York. Unfortunately Dr. Goesling, the German chemist who was to superintend the manufacture of glucose, died before the first lot of glucose was marketed, and with him perished some of the secrets of manufacture. The small stock of glucose made was stored in the refinery, where later upon examination it was found in a solid condition, which alarmed the stockholders, for they knew of no use for grape-sugar, the name given to starch-sugar in its solid form. Neither knew they how to manufacture the glucose as a liquid substance. Their main dependence, Goesling was gone, and there seems to have been a lack of push, courage, and foresight on the part of the officers and stockholders of the Union Sugar Company in that they failed to secure expert chemists to work out the secrets of a process known only to Goesling. The few barrels of glucose the company owned were sold to the Tribune Association for a nominal sum, for use in the printing-rooms, after which the company came to grief, having paid $600,000 for the patents subject to a right to manufacture that belonged to a man named Fox. In 1877 the receiver of the Union Sugar Company sold for $2.50 the patents it controlled. A. W. Fox & Company did better. They improved the process and, while at first they used 200 to 300 bushels of corn per day, they gradually increased the quantity until thousands of bushels were daily required. In 1874 the Buffalo Grape-Sugar Company was organized; it grew into a vast concern, and might be said to be the parent of the present industry.

In 1884 there were 29 factories engaged in the manufacture of sugar or syrup from corn and having a combined capacity for absorbing 40,000 bushels of corn per day. At present there are five factories which in 1902 used an average of 175,000 bushels of corn every day. Four of the five companies are constituent properties of the Corn Products Company. The other, the New York Glucose Company, Shadyside, N. J., is of recent construction and is the only independent establishment in the country. The authorized capital of the Corn Products Company is $80,000,000. The process of manufacture has been greatly improved, so much so that, while in 1882 26 to 30 pounds of glucose was obtained from one bushel of corn, 40 pounds is now obtained. Glucose forms one of the leading exports, besides being very extensively used by brewers, candy-makers, preservers, honey-dealers, and manufacturers of vinegar.

Manufacture, Composition, and Commercial Standard.— The manufacture requires 80 hours, and includes 18 processes of manipulating the corn and starch obtained therefrom: (1) steeping; (2) grinding; (3) separation of the starch; (4) cleaning the starch; (5) collecting the starch; (6) washing the starch; (7) conversion by the action of hydrochloric acid; (8) neutralization; (9) bag-filtration; (10) bleaching with acid; (11) bone-black filtration; (12) concentration; (13) second bag-filtration; (14) acid treatment; (15) second bone-black filtration; (16) final concentration; (17) final filtration; (18) final treatment. After the corn is steeped it is ground in water, and the wet starch separated and converted in copper converters by the action of hydrochloric acid, which is later neutralized by chalk or other alkali; subjected to filtration, then concentrated in a vacuum-pan until it tests 41° Baumé or higher, the difference being in the amount of water eliminated; the product, glucose, a liquid substance, or grape-sugar if the process of conversion is carried farther.

The following observations are taken from a paper on 'The Determination of Glucose,' by Edward Gudeman (1902), Bulletin No. 73, Bureau of Chemistry, United States Department of Agriculture. Glucose is a thick amber-colored syrup 41° to 45° Baumé, containing 13 to 22.5 per cent of water. Grape-sugar is a solid 41° to 45° Baumé, containing 11 to 21.0 per cent of water. The old standard Baumé scale is still used in this industry, and the determinations are made at 140° F., results reported at 100° F., a correction of one degree being made for every 40° F. The standard accepted by the manufacturers and the trade is specific gravity 1.41152 — 42° Baumé. The conversion of starch with acids gives the commercial products known as dextrin, glucose, grape-sugar, and anhydrous grape-sugar (dextrose). Starch and its conversion products do not contain over 1 per cent impurities.

"If the conversion of starch with acid is carried to a point where a dilute iodine solution will just give a distinct color-reaction, we have glucose; continued to where 95 per cent alcohol gives a faint cloud, hardly a precipitate, we have grape-sugar containing about 85 per cent reducing-substance. For still higher converted sugars a time-factor must be introduced. Carried beyond a given point, a back conversion takes place, with strong decomposition and loss of purity.

"The ratio of the reducing-substance to non-reducing substance depends on the accuracy in stopping the conversion, for neutralization, at the exact point decided upon. This ratio determines whether the product is glucose or grape-sugar, and no sharp dividing line exists. The rotating powers of glucose and grape-sugar depend absolutely on this ratio. Actually no two batches of commercial glucose or grape-sugar are identical; for all practical purposes they are alike, as a few points either way from the standard decided upon will make no difference in the appearance, taste, or working qualities of these products."

Non-crystallization.— Glucose does not crystallize, as does cane-sugar (sucrose). A chemical process was devised by Dr. Arno Behr for the crystallization of glucose, but it is regarded as impracticable by reason of being too expensive. Dr. Behr added to the liquid glucose a very small quantity of crystallized anhydrous dextrose. The mixture is filled into molds, and in 72 hours will be a solid mass of crystals of anhydrous dextrose. The blocks are next placed in a centrifugal machine to throw out the still liquid syrup, and the anhydrous dextrose remains as a crystalline mass.

Varieties of Use.— Because glucose does not crystallize it is used extensively in the preserving industry. Fruit put up in a syrup wholly or partially made of glucose has a more plump and natural appearance than if preserved in sugar. Comb-honey, when put into glass jars, is surrounded by glucose which does not change in color or character, and therefore the honey always remains pleasing to the eye. It is very largely used for mixing with cane-sugar molasses; in the manufacture of table-syrup; as a substitute for malt in brewing; and very freely in the manufacture of candy. It is said to have from one half to two thirds the sweetening power of cane-sugar. The extent to which glucose is used in the making of jams, jellies, marmalades, preserves, and canned fruit, together with tables showing the composition of commercial glucose and the composition of the ash of glucose, has recently (1902) been stated in Bulletin No. 66, Bureau of Chemistry, United States Department of Agriculture; also with extensive tables showing the composition of the jams and other preserves in comparison with such as contained no glucose. This bulletin was prepared under the direction of W. D. Bigelow, chief of food laboratory.

Glucose is very largely used in the manufacture of confectionery. Some candies are nearly all glucose, particularly such as are sold for a penny. In the high-grade confections the finest grade is used, not as a substitute for sugar, but in the place of cream of tartar to "kill" or soften the grain of sugar, for which purpose only a small quantity is used. It is also used as a substitute for malt in the brewing of ale or beer, it being claimed that a lighter beer results than when pure malt is used, and that it is more palatable. It is assumed that converted glucose is the same as the glucose which results from the action of diastase in changing the starch in malt into maltose sugar. By using glucose direct, trouble and expense are saved to the brewer, as he is not compelled to use materials which are, in the process of the brew, converted into glucose or grape-sugar. It is claimed that 100 pounds of glucose or grape-sugar is equal to 123 pounds of barley-malt, and is much cheaper. Various publications of the United States Department of Agriculture and the reports of Congressional committees contain a great deal of information on the use of glucose in brewing.

The Wholesomeness of Glucose.— This is really the most important question connected with glucose, and one that is still unsettled. It is a problem for the physiologist rather than the chemist. Owing to many improvements made in the last 20 years, the conclusion rendered by the government's experts in 1884 could be made much more emphatic in 1903. It was as follows: "The starch-sugar thus made and sent into commerce is of exceptional purity and uniformity of composition, and contains no injurious substance. Though at best having only about two thirds the sweetening power of cane-sugar, yet starch-sugar is in no way inferior to cane-sugar in healthfulness, there being no evidence before the committee that maize starch-sugar, either in its normal condition or fermented, has any deleterious effect upon the system, even when taken in large quantities."

On the other hand, E. H. Bartley, M.D., professor of chemistry and toxicology in the Long Island College Hospital, in a paper read before the American Chemical Society, 12 Jan. 1895, claims that glucose promotes gastric disturbances. "The principal forms," he says, "in which sugar is presented to the stomach by nature's foods are either milk-sugar or cane-sugar. These sugars are very different in properties from dextrose, and require digestion before they can be used in the body. They are not capable of assimilation as such, and must be converted into a glucose before they can be used, and this is only done in the intestine. From this it would seem that it was not intended that dextrose and levulose should be taken in any considerable amount in our food. They are not natural, but artificial foods. . . . It is not a rare thing to find persons who can eat rock-candy or maple-sugar with no unpleasant after effects, but the same amount of ordinary glucose-candy will cause distress or produce what is known as 'bilious vomiting.'" Dr. Bartley adds that he has "known several cases of death produced in this way, and in every case it was with candy containing glucose." On 4 Sept. 1903 Dr. Bartley confirmed the statement quoted above, and expressed the opinion that "glucose is not a wholesome food," and that "much damage is done by a too free use of it. The fact is that diabetics lose flesh rapidly. I can therefore believe the statement that while we know that cane-sugar, maltose, and milk-sugar will fatten, glucose will not."

Other authorities give an opinion similar to that of Dr. Bartley; but doctors disagree, and some of them certify that glucose is pre-eminently a fat-forming, heat-producing food; not only not injurious, but an essential article of food, with-

out which in some form man cannot enjoy life. Such statements are based on the theory that chemistry and nature work by identical methods and produce identical substances. Says Dr. Cyrus Edson of New York: "Chemistry has shown man how to imitate exactly the product of nature. The honey of the flower and numerous other products of nature's laboratory can not only be imitated by man, but exactly reproduced by him through the agency of chemistry."

Dr. H. W. Wiley, chief chemist of the United States Department of Agriculture, testified before a committee of the United States Senate as follows: "I have had occasion to make careful examinations of almost every variety of food that has ever been exposed upon our markets for sale. In my opinion glucose is not deleterious to health. It is wholesome, somewhat sweet, readily digested. I have always found, from the time I first began to investigate food products, that the series of foods known as glucose or grape-sugar, when properly made, are valuable food material and not injurious."

The settlement of the vexed question of the wholesomeness of glucose, and its dietetic value as compared with cane-sugar, may be left to the physiologists. It is sufficient to add here that at least $50,000,000 is at present employed in its manufacture; that the industry is a great boon to the farmer, and adds materially to the revenue of the corn-producer; that official figures indicate that 1,200,000,000 pounds of cereal sugar and cereal syrup are annually consumed in the United States, while the foreign demand for them is constantly growing; that the exports of glucose or grape-sugar more than doubled from 1893 to 1901, rising from 101,546,814 pounds to 204,209,974 pounds; that in seven months of 1903 they reached 91,267,920 pounds, valued at $1,727,969, or 1.9 cents per pound; and that during 10 years, 1893–1903, the total exports were 1,708,201,551 pounds, valued at $28,139,768, or 1.06 cents per pound.

Bibliography.— Dubrunfaut, 'Sucrage des Vendages avec les Sucres raffinés de Canne de Betterave'; Frankel, 'Practical Treatise on the Manufacture of Starch, Glucose, Starch-sugar, and Dextrine, Based on the German of Ladislaus von Wagner'; National Academy of Sciences, 'Report on Glucose'; prepared in response to a request made by the commissioner of internal revenue, with bibliography of starch-sugar arranged chronologically (1790–1883) (Washington 1884); 'Glucose in Confectionery,' a statement from the National Confectioners' Association of the United States (Philadelphia 1898); Glucose Sugar Refining Company, 'Statistics of the Glucose Industry' (Chicago 1898).

F. N. Barrett,
Of the 'American Grocer,' New York.

Glucosides, gloo'kō-sīdz, a large class of substances occurring in plants, which are distinguished by decomposing under the influence of ferments, acids, and alkalies into sugar and usually one other substance the nature of which differs with different plants. The composition of the glucosides varies, sometimes nitrogen is present, but in general the compound consists only of carbon, hydrogen, and oxygen. Their constitution is practically unknown; they have never been formed synthetically; only a few seem to be of the nature of compound ethers. When decomposed by the agents above mentioned they assimilate water, and usually yield glucose or dextrose, but some glucosides furnish other kinds of sugar. Of these naturally occurring compounds may be mentioned æsculin, colocynthin, which yields sugar and colocynthein; convallarin; convolvulin; crocin; daphnin; datiscin; digitalin; euxanthic acid; fraxin; gallotannic acid or tannin; glycyrrhizin; jalappin; phloridzin; populin; quercitrin; salicin; scammony; and xanthorhamnin. The following contain nitrogen; amygdalin; chitin; gelatin or isinglass, which when boiled for a long time with dilute sulphuric acid decomposes and yields a sugar; solanin; and myronic acid, in which sulphur is also present. The majority of these bodies are described under their respective heads. Amygdalin (q.v.) was the first known glucoside.

Glue, an impure gelatine, used as an adhesive, and commonly prepared from the clippings of hides, hoofs, horns, and sinews. These are steeped in lime-water, to remove the hair and blood, and then drained and dried in a current of air, that the lime may absorb carbonic acid, and thus prevent the injurious effects of the alkali upon the gelatine. The dippings are then boiled in water until the solution is found to gelatinize firmly on cooling. The impurities are allowed to settle, and the residuum to gelatinize in shallow wooden boxes; it is then cut into slices and dried upon nets. Good glue is semi-transparent, and free from spots and clouds. Marine glue, a composition used for cementing materials that are exposed to moisture, is made by dissolving 1 part of india-rubber in 12 parts of mineral naphtha, and adding 20 parts of powdered shellac; it resists wet, and cements glass and metals as well as wood. White fish-glue, or diamond cement, is made of isinglass dissolved in alcohol.

The glue industry in the United States was founded by Peter Cooper in 1827, when he established a factory in Brooklyn. About the same time a factory in Philadelphia was started by Charles Baeder and William Adamson. At present glue factories are centralizing near the great slaughter-houses of the Middle West, the sources of raw supplies, and the larger packing concerns, notably the Armours and the Swifts in Chicago and the Cudahy Company in Omaha, have their own glue plants. (See Packing Industry.) The factories still in the East are largely supplied with imported hides. The export trade is steadily growing and has passed the $500,000 mark per annum. France alone surpasses America in the quality of its finer glues, and these are imported for use in making straw hats. The finest glues made in the United States are prepared from sinews, and it is likely that continual experiment upon them will result in a product equal to the best imported from France. The following statistics show the growth of the industry since 1880:

GLUE FACTORIES IN THE UNITED STATES, 1880-1900.

	1880	1890	1900
Number of establishments	82	62	61
Capital	$3,916,750	$4,859,266	$6,144,407
Wage earners	1,801	1,697	1,618
Wages	$600,018	$676,089	$685,096
Cost of materials	$2,786,342	$2,510,927	$3,767,023
Value of products	$4,324,072	$4,270,460	$5,389,006

Glut-herring, or **Blueback**, a herring (*Pomolobus æstivalis*), abundant in the Southern States, and very similar to the alewife (q.v.), but it is more elongated, is darker on the back and has a black peritoneum and comparatively small eyes. The quality of its flesh is poor.

Gluten (Lat., glue), that constituent element in the vegetable kingdom which makes muscle and builds tissue. It is a combination of two substances, glutenin and gliadin, the latter forming about two thirds, the former one third, as found in wheat. It is a variable constituent of cereals that is now separated from the grain and used for human food and animal feeds. It has been designated as the spinal column in all vegetable life, and is a nitrogenous substance, belonging to the albuminoids, such as the white of egg, the lean of meat, etc. The "hard" wheats are richer in gluten than the "soft" varieties, and the gluten obtained from wheat is of higher dietetic value than the gluten of corn or rye, the latter being soft and of peculiar odor.

To obtain gluten from wheat, the grain is reduced to dough, and the starch removed by mechanical processes, the resultant product being a grayish, tough, elastic, sticky substance which, when produced in its purity and rightly proportioned in its gliadin-glutenin content, is capable of being drawn out into long bands or shreds.

In its highest refinement, gluten exhibits a fine molecular structure, delicate and sensitive to atmospheric conditions, and requires, after separation, immediate handling in its preparation for food.

About 16 pounds of gluten is obtained from 200 pounds of wheat-flour. On account of its high content of nitrogen, gluten soon deliquesces, sours and spoils after the separation from the starch, and demands an immediate treatment if desired for food purposes.

There is great variation in the character of the so-called gluten foods on the market, some of which are almost worthless and a fraud upon the public. Analyses made by the United States Department of Agriculture, by the Maine agricultural experiment station, and other agricultural stations, the results of which may be found in various bulletins issued by these organizations, show that many of the so-called glutens generally found on the market are scarcely better than ordinary white flour or bread.

The glutinous and other residues from the manufacture of starch and glucose are dried and made into cattle-feed, having a nutritive value about equal to brewer's grains. The glucose and starch makers assume that maize or corn consists of starch, gluten, germ, and bran, all but the starch being by-products, which are separated by injurious mechanical processes. The wet or free germs of the corn are dried, ground to meal, the oil extracted by hydraulic pressure, leaving oil-cake, a cattle-feed extensively used. The wet starch is run over vibratory sieves and over long wooden tables, the starch and gluten forming the mixture which passes through the sieves; the starch being deposited by gravity, the gluten passes off at the ends of the tables, forming wet gluten, which, when pressed and dried, constitutes the gluten-meal of commerce. About 5½ pounds is obtained from one bushel of corn.

The composition of gluten-meal is, protein 38 per cent, fat 3 per cent, and starch 40 per cent. This is one of the richest and best food products on the market. The nutritive value is very high, and the factor of digestibility ranges from 92 to 96 per cent. The gluten-meal is treated for the recovery of its starch, and gives two new products, a concentrated foodstuff, characterized by the large amount of proteids (60-70 per cent) it contains, and a maltose syrup. This foodstuff is suitable for animal consumption, and also for raising the percentage of proteids in feeds that have a small amount of these substances. When the wet bran and the wet gluten are mixed in the proportions as obtained from the original corn and the mixture dried, the resulting feed is known as gluten. This is the most common food product in the starch and glucose industry, and represents about 80 per cent of the food output. Its feeding value is very high, and its digestibility above 90 per cent. Its composition is about 28 per cent protein and 3 per cent fat.

Corn oil cake and gluten-meal are exported extensively. The bran and gluten feed is used almost exclusively in the United States. The production per bushel of corn is about 12½ pounds of feed.

The New York agricultural experiment station Bulletin No. 198, November 1901, gives the result of analyses of feeding stuffs. The gluten-feed was of sorts ranging in price from $19 to $22 per ton. They show a protein content of from 14.8 per cent to 28.7 per cent; fat, 2.4 per cent to 5.6 per cent; some contained as high as 11.7 per cent crude fibre. Gluten-feed, made in Buffalo, from 24.9 per cent to 27.4 per cent of protein, sold under guarantee of 28 per cent; fat, 2.7 per cent to 4.2 per cent, sold under guarantee 3.3 per cent. Prices, $20 to $21 per ton. Gluten-meal, made in Chicago, 36.8 per cent to 39.1 per cent protein; 3.0 to 4.8 per cent fat; price $24 to $25 per ton.

The waste product in the manufacture of starch or sugar is relatively much richer in oil and protein than is corn. Most factories are removing part of the corn-oil from the waste, so that nearly all the gluten-meals carry much less oil than they did a few years ago. Gluten-feeds differ from gluten-meals in that they contain a good deal of the corn-bran, and hence less of protein and digestible carbohydrates, and more of the indigestible woody fibre. The relation of gluten to bread making is set forth in detail in Bulletin No. 67, United States Department of Agriculture. The food value of gum-gluten has been outlined by Prof. Nelson Clark Parshall in a pamphlet published by the Pure Gluten Food Company, New York.

F. N. Barrett,
Of the 'American Grocer,' New York.

Glut'ton (*Gulo*), a genus of carnivorous quadrupeds related to the sables and martens, but larger and distinguished by the moderately elongated head and the long, rather low body. Intermediate between the plantigrades and digitigrades, it has rounded, very short ears, and a simple fold below the tail, which distinguishes it from the badger, which is pouched and which the glutton otherwise resembles. The commonest species in America is the *Gulo borealis* or

luscus, better known as the wolverine; it is about 28 inches from the tip of the nose to the root of the tail, which is about 8 inches long, if the hair at the extremity, 3 or 4 inches long, be included. The body is covered with thick, long hair. In summer its coloring is: face blackish as high as the eyebrows, and between these and the ears whitish or brownish; ears covered with coarse hairs; the lower jaw and the inside of the fore legs spotted with white; the back, thighs, and belly, brown or brownish black; sides, chestnut color. Its fur is of value and is used in northern Asia, where the wolverine is a native, for making and ornamenting robes. The animal, however, does not breed in sufficient numbers to furnish much fur to the traders. It is very voracious — although more so in fable and legend than in actual fact — at the same time slow and heavy in its motions, but remarkably acute in sight and hearing. It is of powerful frame, a match for any animal of its own size, and makes a strong resistance when attacked. It is one of the most destructive quadrupeds found in the northern part of America, killing numbers of young foxes and other animals; it is also a great enemy to beavers, watching for them as they come out into the open, or even breaking into their habitations.

Glycerin, glĭs'ē-rĭn, or **Glycerol.** In 1783 Scheele showed that by acting upon olive oil by oxid of lead a substance may be obtained which has a sweetish taste; and in the following year he showed that the same substance may be had by acting in a similar manner upon other oils and fats, such as butter. He also observed that the substance in question may be obtained in the form of a syrupy fluid; that although it has a sweetish taste like sugar, it cannot be fermented; and that although it gives oxalic acid by oxidation, it differs from sugar in many respects. He failed, however, to ascertain its true relation to the oils which furnish it, and to the lead plaster (or "lead soap") which accompanies its formation. The true explanation of the reactions was given some 30 years later by Chevreul, as a result of his famous researches upon the animal fats, which were begun about 1811, and were concluded about 1823. In the course of these researches Chevreul showed that an animal fat consists, in general, of a mixture of several definite chemical substances, each of which is itself a fat, and each of which consists of Scheele's sweetish substance (which is now called "glycerin"), combined with an organic acid. When the fat is treated with an alkali, or with lime or oxid of lead, the organic acid that is present combines with the alkali, or the lime, or the lead, to produce a new substance called a "soap," the organic base (glycerin) which was previously combined with the acid being thereby set free. Since the time of Scheele and Chevreul much attention has been paid to glycerin and its compounds, and it is now universally agreed that glycerin is a triatomic alcohol (see ALCOHOL), having the formula $C_3H_5(OH)_3$; and that it forms an acid and an oxid, and various substitution compounds and esters, of which latter class the fats (q.v.) are the most important members, and are distinguished by the name of "glycerides."

Glycerin sometimes occurs in nature in the uncombined form, notably as a constituent of palm-oil, and it is also a product of fermentation; but it is obtained on the large scale only by the decomposition of the fats. In soap making the fat is decomposed by heating with an alkali, the soap which is formed by the combination of the alkali with the organic acid of the fat remaining in solution until it is precipitated by the addition of common salt. The fluid that remains after the soap has been so precipitated contains the liberated glycerin, which can be separated by distilling in a partially exhausted boiler, the glycerin passing over with the water vapor, from which it may be subsequently separated by re-evaporation.

Glycerin is obtained in large quantities as a by-product in the manufacture of so-called "stearin" candles. In this case the fat is not saponified by an alkali, but beef fat, or some other fat that is rich in stearin, is acted upon by superheated steam, by which the stearin, or stearate of glycerin, is resolved into free stearic acid and free glycerin. Fat undergoes a similar transformation when treated with a mineral acid; but this method of producing glycerin has the disadvantage that the mineral acid is likely to combine to a certain extent, either with the glycerin, or with the liberated fatty acid, necessitating a subsequent treatment for its removal.

Pure glycerin is a colorless, odorless, syrupy liquid, with a pronounced sweet taste, and a specific gravity of about 1.27. It is insoluble in ether, but it mixes in all proportions with water and with alcohol. It has a considerable affinity for water, and absorbs moisture from the air quite readily. It boils at about 600° F., but with partial decomposition. Under reduced pressures it boils at lower temperatures. At a pressure of 12.5 millimetres of mercury, for example, it boils at 356° F., and may be distilled without change. By freezing, absolutely pure glycerin may be obtained in the form of deliquescent crystals, belonging to the trimetric system, and melting at about 68° F. Glycerin burns with an almost colorless flame, and dissolves many organic bodies that are insoluble in water. It also dissolves iodine, and many of the metallic oxids.

The solvent properties of glycerin render it valuable in pharmacy. It is also greatly used in the manufacture of nitroglycerin (q.v.), as a constituent of various toilet soaps, creams, and washes, as a preservative medium, and for use in gas meters and other mechanical appliances in which a liquid is needed which will not readily freeze nor evaporate.

Glycin, glī sĭn. See GLYCOCOLL.

Glycocholic (glī-kō-kŏl'ĭk) **Acid,** an organic acid, whose sodium salt is one of the main constituents of the bile of certain of the vertebrates. It may be most conveniently prepared by the following method: A drop of hydrochloric acid is added to fresh bile, and the mixture is shaken and filtered. The filtrate is allowed to stand after being shaken with hydrochloric acid and ether, until the glycocholic acid separates in the form of a bulky mass of needle-like crystals. These are collected upon a filter, washed with water containing hydrochloric acid and ether, and finally purified by recrystallization. Glycocholic acid is slightly sweet and bitter in its aqueous solution. It is readily soluble in alcohol, but dissolves sparingly in water, ether, and other solvents. It forms numerous salts, known as glycocholates, which are all sol-

uble in alcohol. Those of the alkalis are also soluble in water, and yield lathers, like soap. Glycocholic acid has the formula $C_{26}H_{43}NO_6$, and when heated with potash it is resolved into cholic acid ($C_{24}H_{40}O_5$) and glycocoll ($C_2H_5NO_2$), apparently according to the equation $C_{26}H_{43}NO_6 + H_2O = C_{24}H_{40}O_5 + C_2H_5NO_2$.

Glycocoll, glī'kō-kŏl, **Glycin, Glycocin, Amido-Acetic Acid**, or **Gelatin Sugar**, a singular chemical substance obtained by heating glycocholic acid (q.v.) with an alkali, or by the long-continued boiling of gelatin, glue, or gelatinous tissues, with sulphuric acid, or with potash or baryta. When perfectly pure it crystallizes in tabular, monoclinic crystals; but slight quantities of certain impurities induce remarkable changes in its crystalline form. It is insoluble in alcohol and in ether, but is sparingly soluble in water, its solution having a sweet taste. According to its mode of formation from glue, glycocoll is a sugar, the glue acting the part of a glucoside; but it resembles an acid (although it is neutral to litmus paper) inasmuch as it combines with metallic oxids to form salts. It does not form salts with the metals of the alkalis, and probably not with those of the alkaline earths. In combining with acids, glycocoll acts as a base, forming definite salts such as the nitrate, acetate, oxalate, sulphate, and hydrochlorid. In these compounds the glycocoll has strongly basic properties, and, indeed, it is usually described as a base. The chemical formula of glycocoll is $C_2H_5NO_2$; or $CH_2(NH_2).COOH$.

Glycogen, glī'kō-jĕn ($C_6H_{10}O_5$), animal starch, a substance found in the livers of most animals, and to a very large extent in the muscles and other parts of fœtal animals. It is extracted from the liver of a newly killed animal by cutting the liver in pieces, plunging it into boiling water, triturating it to a fine paste, and extracting with water. The filtered fluid is mixed with moderately strong alcohol, which throws down a flocky precipitate. This is purified from coloring and nitrogenous matter, and at last the glycogen is obtained as an amorphous white powder, without taste or smell. It dissolves in water, but the solution is not absolutely clear; it is insoluble in alcohol. By boiling with acids, or by the action of ferments, glycogen is readily converted into sugar. By nitric acid it yields oxalic acid. The chief interest attaches to the physiological function of this substance, and the very discordant views taken with regard to it by different writers. Thus it is said to be the substance in the liver mainly concerned in the conversion of starch into sugar. Other physiologists affirm that no such transformation takes place, there being no proof of the increase of sugar after the action of the liver; so that at the present time its exact functions are unknown. It has been suggested that the sugars that are taken into the system with the food are stored up in the liver in the form of glycogen, to be drawn upon subsequently, according to the needs of the system.

Glycol, or **Ethylene Alcohol**, the most important of the dihydric alcohols (see ALCOHOL and FATTY COMPOUNDS) may be regarded as derived from the hydrocarbon ethane, C_2H_6, by the substitution of two molecules of hydroxyl (OH) for two molecules of hydrogen. It therefore has the formula $C_2H_4(OH)_2$. Glycol may be prepared by acting upon ethylene dibromide, $C_2H_4Br_2$, by potassium carbonate, K_2CO_3. The reaction is $C_2H_4Br_2 + K_2CO_3 + H_2O = C_2H_4(OH)_2 + 2KBr + CO_2$. Glycol is a colorless, odorless liquid, having a specific gravity of about 1.12, and a sweetish taste. It boils at about 388° F., and solidifies at 11° F. It mixes in all proportions with water and alcohol, and is used to some extent as a solvent. A great many compounds have been derived from glycol, but they are not of general interest. The word "glycol" is also used as a generic name for all the dihydric alcohols.

Glycollic (glī-kŏl'ĭk) **Acid**, or **Oxyacetic Acid**, an organic acid having the formula $HOCH_2.COOH$, whose potassium salt (that is, potassium glycollate) exists in the grease obtained from sheep's wool, and in the juice of unripe grapes. It may be prepared by heating a mixture of glycerin, water, calcium hydrate, and precipitated silver oxid for four hours, after which the fluid is filtered, saturated with carbon dioxid, boiled, filtered again, and finally evaporated until calcium glycollate crystallizes out. The calcium glycollate is next decomposed by oxalic acid, and the filtered solution is neutralized with carbonate of lead. Upon evaporation, well-developed crystals of lead glycollate separate out; and a solution of these, when treated with the proper amount of sulphuric acid, yields free glycollic acid. By evaporation in a vacuum over concentrated sulphuric acid, and subsequent recrystallization from solution in anhydrous ether, the acid may be obtained in a very pure form. It is freely soluble in water, in alcohol, and in ether. Concentrated nitric acid oxidizes it to oxalic acid; and when distilled with excess of quicklime it decomposes with liberation of methane and hydrogen. Glycollic acid forms an extensive series of salts called glycollates, and it also yields numerous esters and other organic derivatives.

Gly'cosides, a class of vegetable principles which under the influences of heat, enzymes, or chemical action split into some form of sugar and some other body. Those glycosides which split into sugar and some other body are known as glucosides. When the sugar is rhamnose they are known as rhamnosides; if arabinose, they are known as arabinosides, etc. There are a great many glycosides in nature, and within recent years a large number have been made artificially. The chemical composition of the artificial glycosides is well understood, since they are the result of synthesis, but the make-up of the natural glycosides is not well understood. Glycosides play a very important role in nature. By reason of their bitterness and of their often being poisonous, they preserve seeds from destruction by animals, man included, until they shall have ripened, and then on germination plant enzymes or ferments acting on the glycosides set free a certain amount of sugar, which is of much service to the young developing plant. An excellent illustration of their protective qualities is seen in persimmons, which, when green, are so puckery by reason of the glycoside tannic acid that they are left severely alone. When ripe, however, the tannic acid is converted largely into sugar, and the fruit, then eaten and carried about by animals, can distribute its seed. In wild-cherry bark and in bitter almonds there is a glycoside amygdalin which is con-

verted into sugar and hydrocyanic acid. In mustard the glycoside sinagrin acted upon by the plant ferment also found in the seed develops into sugar and the volatile oil of mustard plaster. Many fungi are capable of accompanied by its special ferment. Many glycosides are affected by heat. Some are split by cooking in water, but a boiling temperature is apt to destroy the action in many. Thus it is necessary to use cold water if one desires to obtain the volatile oil of mustard in making a mustard plaster. Many fungi are capable of breaking down glycosides, which fact is of a great deal of practical importance in medicine, for many active remedies which contain glycosides, if kept too long on the druggist's shelf, develop molds within them. These destroy the active principle of the drug and thus render it useless. In medicine the most important glycoside containing drugs belongs to what is known as the "digitalis group." Thus digitalis contains four or five, strophanthus two, apocynum two, and squills the same number. These bodies are all heart tonics in small doses and heart poisons in larger amounts. Consult Van Rijn, 'Die Glycoside' (1900).

Glycosuria, the presence of glucose in the urine. See DIABETES MELLITUS.

Glycyrrhizin, glĭs-ĭ-rī'zĭn, or **Liquorice Sugar,** a peculiar organic substance which occurs in liquorice root (*Radix Glycyrrhizæ*), together with starch, malic acid, and various other matters. It may be prepared by extracting the dried and pulverized liquorice root with boiling water containing a small quantity of milk of lime, and precipitating the concentrated extract with cold acetic acid. The gelatinous precipitate is purified by dissolving it in 50 per cent alcohol, filtering through charcoal, and finally evaporating at 212° F. When dry, glycyrrhizin is an amorphous solid, which swells up in cold water but does not dissolve. It is only slightly soluble in alcohol or ether, but dissolves in hot water, and also in boiling glacial acetic acid. It reduces Fehling's solution when heated, and has been regarded as a glucoside; but although boiling with dilute acids decomposes it, it does not appear that any glucose or other sugar is formed, the chief products of the decomposition being parasaccharic acid and a brownish resin called glycyrrhetin. Glycyrrhizin is now more commonly regarded as a tribasic organic acid, and the name "glycyrrhizic acid" has been assigned to it. It has the probable formula $C_{44}H_{63}NO_{18}$, and forms numerous salts, which mostly have a sweet taste.

Glyoxal'ic Acid. See GLYOXYLIC ACID.

Glyox'aline, a substance having the chemical formula $C_3H_4N_2$, and prepared by acting slowly upon cold glyoxal with strong ammonia in slight excess. Glycosine is thrown down as a precipitate, and the filtrate, which contains glyoxaline, is boiled with milk of lime (to expel the ammonia), after which it is evaporated to a syrupy consistency, treated with absolute alcohol, and filtered. The liquid so obtained is distilled, yielding pure glyoxaline in a crystalline mass of dazzling whiteness. Glyoxaline melts at 192° F., and boils at 491° F. It is freely soluble in water, alcohol, and ether, and has an alkaline reaction. It acts as a base, and forms salts. It is also the starting point for a series of organic compounds of analogous composi-glycollate and calcium oxalate.

Glyoxyl'ic or **Glyoxalic Acid,** an organic acid having the formula H.CO.COOH, and existing in the unripe fruits of many plants. It may be prepared (along with glyoxal) by oxidizing alcohol with nitric acid. It is a thick, syrupy liquid having a specific gravity of about 1.3, and when allowed to stand over concentrated sulphuric acid it crystallizes in trimetric prisms containing water. Glyoxylic acid is very soluble in water, and can be distilled in a current of steam. It is a monobasic acid, forming crystalline salts called glyoxylates. By oxidizing agents it is converted into oxalic acid; by nascent hydrogen it is reduced to glycollic acid. It has also the properties of an aldehyde, reducing ammoniacal solutions of silver salts, forming a metallic mirror; also unites with alkaline bisulphites. Glyoxylic acid, when boiled with excess of lime water, yields calcium glycollate and calcium oxalate.

Glyp'todon, the typical genus of the extinct glyptodontia, or tortoise-armadillos, of South America. The back was covered by a solid bony carapace, without any movable rings such as the armadillo possesses, so that the animal was unable to roll up into a ball for protection; but the tail was protected by a succession of overlapping bony rings, and the head by a stout bony casque, while there was usually more or less armor on the under side of the body. The legs and feet were short and stout, and had hoofs on the toes instead of claws. The animal was 10 to 12 feet in length.

Gmeiner, John, American Roman Catholic clergyman: b. Bärnau, Bavaria, 5 Dec. 1847. He studied at St. Francis' Seminary, Milwaukee, Wis., was ordained priest in 1870, was professor in the seminary, and later in St. Thomas' Seminary, St. Paul, Minn. In 1899 he became rector of St. Francis' Church, Buffalo, Minn. In 1893 he addressed the World's Parliament of Religions at Chicago on "The Primitive and Prospective Religious Unity of Mankind." His published writings include the volumes: 'Modern Scientific Views and Christian Doctrine Compared'; 'Emmanuel: the Saviour of the World'; 'Mediæval and Modern Cosmology.'

Gmel'inite, mĕl'-ĭ-nīt (for Prof. Charles Gmelin), a native hydrous silicate of aluminum, calcium and sodium, crystallizing in the rhombohedral system, usually with a hexagonal aspect. It is colorless or white, often with tinges of yellow, green or red, and transparent to translucent, with a vitreous lustre. It is brittle, with a hardness of 4.5 and a specific gravity of about 2.1. It loses much of its water of crystallization when heated in a closed tube, and dissolves in hydrochloric acid, with separation of free silica. Gmelinite occurs in the Harz Mountains, in Cyprus, and in parts of Italy and Ireland. It is also found at Cape Blomidon and at other points along the coast of Nova Scotia, and fine white crystals of it occur at Bergen Hill, N. J. The mineral was formerly called "hydrolite."

Gnadenhütten, gnä'dĕn-hüt-tĕn, **Massacre at.** For the westward retreat of the Delawares, and their partial conversion to **Chris-**

tianity by the Moravians, see their name. In 1772 their Great Council settled the Christian Indians on the Muskingum in three villages, Salem, Schönbrunn, and Gnadenhütten (Tabernacles of Grace), the latter being that of the Delawares. Through the Revolution these Indians as a body took no part in warfare, quietly cultivating their farms; but some of the younger ones joined the war-bands, which forced the Moravian villages to give them supplies and shelter. The whites were wrought up to frenzy by their atrocities, in which they accused the Christian Indians of being secret participants; and in 1781 a successful foray against the hostiles was only prevented from involving the Moravians by the efforts of Col. Brodhead. But the first blow against them was struck by the wild Indians and British. In the fall of 1781 Capt. Matthew Elliott, under orders from the British commandant at Detroit, with a body of white rangers and a miscellaneous horde of Indians from a half-dozen different tribes, forced them to leave their villages, which were half destroyed; the missionaries were taken to Detroit, and the Christian Indians left on the Sandusky plains, where the wild Indians would have massacred them but for the English. A few escaped and returned to the villages; they were captured by the Americans under Williamson, and taken to Fort Pitt, whose commandant, Gibson, their firm friend and attempted protector, sent them back to the villages unharmed. During the winter the rest suffered much from cold and hunger around Sandusky, and by the spring of 1782 some 150 had returned to the villages. Meantime the fiendish Indian outrages were going on; the borderers accused the Moravians of being privy to them, and denounced Gibson and Williamson for letting them go; and after a woman and child had been impaled alive by an Indian gang, who afterward refreshed themselves among the Moravians, the whites formed a party of near a hundred under Williamson to exterminate the latter. In March they gathered those in Salem and Gnadenhütten into two houses at the latter — those at Schönbrunn had been warned and escaped — under promises of good treatment: a council was held, at which 18 protested against the contemplated murder and withdrew, taking an Indian lad with them; the rest went in and killed the 96 inmates, after the latter had prayed and kissed each other farewell, only two other boys escaping. The best men of the borders denounced the cowardly butchery in unsparing language.

Gnat, năt, a somewhat indefinite term applied to various forms of small two-winged flies, especially those annoying to man and domestic animals. In England mosquitoes are known as "gnats," but in America the term is more restricted to species of the genus *Simulium*, known also as "buffalo gnats," "black-flies," and "turkey gnats," or midges. One of the most remarkable of these species on account of its minute size is the so-called punky or "no see um" of northern woods. The buffalo gnat is quite as bloodthirsty as the mosquito, but is most annoying to domestic animals, including poultry, which are frequently worried to death by swarms of it. These gnats differ from mosquitoes in that they are diurnal, while the latter normally fly by night. The larvæ of most of the gnats, with the exception of the gall and fungus gnats (qq.v.), are aquatic and do no harm in this stage. There is also a distinctive form of gnats which occur throughout the country, but reach their highest development in the Gulf States. The common species are *Hippelates flavipes* and *H. plebejus,* which in Florida occur in great numbers, and are the direct cause of the disease "sore eye" which from time to time becomes epidemic in the rural districts.

Gnat-catcher, or **Gnat-snapper,** any of various little birds that snap up minute insects on the wing. Specifically, in the United States, a small bluish-gray flycatcher (*Polioptila cærulea*), common from Maryland southward, and noted for the exquisite finish of its soft, lichen-covered nest, saddled upon a horizontal tree-limb. See Maynard, 'Birds of Florida' (1872).

Gnathobdellida, năth-ŏb-dĕl'lĭ-da, an order of leeches (q.v.), distinguished by the absence of a proboscis.

Gneiss, nīs, a metamorphic rock, consisting of orthoclase, quartz, and mica. It is akin to mica schist, but contains more orthoclase and less mica; it has the same components as granite, but is stratified or foliated. The geological genesis of gneiss is obscure. One theory is that gneiss is the result of the metamorphism of sedimentary rocks; on this hypothesis gneiss is closely related to conglomerate, which is a mixture of sedimentary pebbles and fine grains resulting from the action of water, while gneiss owes its stratified form to other causes. In some cases this sedimentary theory may hold, but in others it is evident that gneiss is the production of eruptive forces, occurring, as it does, in purely igneous rocks. In the United States gneiss, in the ordinary usage of the term, is common, notably in New England and New York, the strata running northeast and southwest. It abounds in the mountains of central and northwestern Europe and in the ranges of South America. Gneiss is used as a building stone and for flagging.

Gnomé, nō-mā (Gr. "judgment," "advice"), a short, pithy saying, often expressed in figurative language, containing a reflection, a practical observation, or a maxim. Gnomes are a common form of early literature. In religious literature the proverbs of Solomon, those of Jesus, son of Sirach, and the sermon on the mount, are examples. The Sæmundian Edda has preserved excellent proverbs whose authorship is attributed to Odin. The word generally connotes Greek maxims or monitions, and Theognis, Phocylides, and others, are called the Gnomic poets, from their excellence in this sententious manner of writing.

Gnome (nōm) **Owl,** one of the burrowing or "elf" owls of the American plains: specifically, *Glaucidium gnoma.*

Gnomes, in European folk-lore, spirits which dwell in the interior of the earth, where they watch over hidden treasure, and hence are the patrons of miners. Ugliness is their appropriate quality, though the females, gnomides, are beautiful. Among them all Rubezahl (Number-nip) has obtained, by means of Musæus' popular tales, the greatest celebrity in Germany. The native country of these poetical beings is the East, whence they were introduced into Europe

between the middle of the 15th and the beginning of the 16th century by the cultivators of cabalistic philosophy, Pico of Mirandola, Marsilius Ficinus, Paracelsus, Cardanus, and Reuchlin. The gnomes make a part of Pope's machinery in the 'Rape of the Lock.'

Gnomon, nō'mŏn, an astronomical instrument for measuring the altitudes and declinations of the sun and stars. It is usually a pillar or pyramid, erected upon level ground or on a pavement, and is especially used for making the more important observations. Many have preferred it to the smaller quadrants, both as more accurate and more easily made and applied. The most ancient observation of this kind extant is that made by Pytheas, in the time of Alexander the Great, at Marseilles, where he found the height of the gnomon was in proportion to the meridian shadow at the summer solstice, as 213½ to 600. This method of observation was by no means accurate in ancient times, since observers did not take into account the sun's parallax, which makes his apparent altitude less than it would be if the gnomon were placed at the centre of the earth; they also neglected refraction, by which the apparent height of the sun is somewhat increased; and made their calculations as if the shadows were terminated by a ray coming from the sun's centre; whereas it is bounded by one coming from the upper edge of his limb. These errors, however, may be easily allowed for; and, when this has been done, the ancient observations are generally found to coincide nearly with those of the moderns.

Gnomon, in geometry, is the space included between the lines forming two similar parallelograms usually squares, of which the smaller is inscribed within the larger, so as to have one angle in each common to both. For the gnomon of a dial see DIAL.

Gnossus. See CNOSSUS.

Gnosticism, nŏs'tĭ-sĭzm (Gr. γνῶσις, knowledge; γνωστικός, devoted to knowledge), the teaching of various sects in the first Christian century, who hovered on the borderland between Christianity and heathen thought. The systems they founded attempted to grapple with the most profound problems of philosophy, such as the creation of the world and the origin of evil. They taught that a series of divine emanations connected the Supreme Being with the visible universe: that human nature was dual, and that the acts of the body had no influence on the spirit. They blent their ideas of Christian truth with pagan and Jewish elements, or even with those received from the common belief in magic. They taught that the earthly life of Christ was unreal, that is, he was a phantom and incorporeal, and they held that knowledge (γνῶσις) as they possessed it, was superior to faith.

Thus there was a general tendency to trace the same religious idea through different mythologies (which were held to be the popular expression of religious ideas originally revealed), and the new religion which aimed at the redemption of the whole world was eagerly seized on as the embodiment of their unifying principle. Christianity was believed to be the full revelation of the deeper truth embedded in all the nature-religions. By adapting their presentation of Christianity to the form of the ancient mysteries the Gnostic teachers the more easily fastened themselves upon the Christian congregations, and succeeded in taking up a position within them as specially initiated persons, for which they found a natural support in the prevalent ascetic views and the powerful influence of free prophecy. But these were in time forced to separate themselves, and form sects, whose great diversity becoming the more apparent greatly counteracted the influence of the Gnostic leaven in the Christian communities. To maintain their theories in the face of the traditional doctrine of the churches they had recourse to the sources of that doctrine. They claimed to have special traditions from certain of Christ's disciples, and applied their exegetical skill to the allegorical interpretation of the written monuments of the apostolic age. Marcion (about 150), believing himself to be a consistent follower of Paul, rejected the authority of the earliest apostles, as well as the gospels emanating from the circles of their influence, and professed to hold "the gospel" known to Paul only. His collection of 10 epistles of Paul was the first attempt to fix the canon of the apostolic Scriptures. Such arbitrary treatment of the Scriptures led the Church to resort to a more through study of the historical tradition. In the struggle with Gnosticism it obtained a firm hold of the principle that that alone is to be held true Christianity which can be shown to be historically derived from Christ and his apostles, and it found the only means to check the license of Gnostic speculation in the development of a Christian theology in accordance with the positive character of historical Christianity.

The general principles of Gnostic thought may be here summarized, as fuller accounts of the principal schools are given under their own names or under those of their founders. For the practical doctrine of the redemption of men's souls from sin by Jesus Christ the Gnostics substituted a speculative doctrine of the redemption of the human spirit from matter by religious knowledge. The realistic eschatology of the primitive Church they entirely set aside. The evangelic element in their teaching was obscured by a cloud of heathen mythologies and philosophic subtleties. The Divine Demiurgos and Lawgiver of the Old Testament was distinguished from the Supreme Being, and the Hebrew idea of creation was superseded by that of a continuous process of emanations from the divine first cause. The present world was believed to be the result of a catastrophe in which the spirit fell under the power of matter, or of an original destiny that powers hostile to God should bring into existence a world in which the spirit born of God should be held in unwilling estrangement from him. All the Gnostic systems are more or less dualistic. In these dualistic theories a philosophical foundation was secured which was by the Gnostics developed to an extreme. The highest duty of man was to become united to the First Source of Spirit through *gnosis* and the absolute alienation of the human spirit from the body. Others, like Carpocrates and his son Epiphanes, expressed their contempt for the flesh and the ordinances of the Demiurgos in unbridled license. The contrasts of the flesh and the spirit and of the world and the kingdom of God are interpreted as the physical conflict of vast cosmic forces,

and are thereby stripped of their moral and religious significance. The intervention of Christ is the crisis, not only of the religious history of mankind, but of the whole development of the universe. As the final and perfect Æon he is distinguished from his visible manifestation. This is held to be (1) a real human life with which he was connected for a time, or (2) a heavenly or "psychical" creation, or (3) a mere phantasm. Men are divided into two classes: the Pneumatic or "spiritual," who are constitutionally receptive of Christ's revelation and life everlasting, and the Hylic or "material," who are doomed to perish. Valentinians and others add a third, or intermediate class, the Psychical, or men of "soul," who are not capable of apprehending a divine revelation, but only of the popular faith (*pistis*), yet thereby may attain to a degree of knowledge and salvation.

The 'Pistis Sophia,' edited by Schwartze and Petermann (Berlin 1853), is the only Gnostic work that has come down to us in a complete form, except those apocryphal Gospels and Acts of the Apostles which show a Gnostic tendency. Tatian's 'Diatessaron' was used in the Syrian Church down to the 5th century. The Gnostic Bardesanes of Edessa, one of the last of the Syrian Gnostics, was the founder of Syrian hymnology. See Mansell, 'Gnostic Heresies'; Neander, 'Genetische Entwickelung der vornehmsten gnostischen Systeme' (1818); Möller, 'Kirchengeschichte,' Vol. I. (1889); Renan, 'Origines du Christianisme'; King, 'The Gnostics and their Remains' (1887).

Gnostics, a religious philosophical sect, who boasted of a deeper insight into the origin of the world, and of the evil in the world, than the human understanding, so long as it remains in equilibrium, can deem admissible, or even possible. Simon the magician, of whom Luke speaks in the Acts of the Apostles, was the first among them. Even in his dogmas we discover the traces of ideas which were common to all the Gnostics. They may be reduced to the following principal heads: The world and the human race were created out of matter by one æon, called the *demiurge*, or, according to the later systems of the Gnostics, by several æons and angels. The æons made the bodies and the sensual soul of man (*sensorium, psyche*) of this matter; hence the origin of evil in man. God gave man the rational soul; hence the constant struggle of reason with sense. What are called gods by men (for instance, Jehovah, the God of the Jews), they say, are merely such æons or creators, under whose dominion man became more and more wicked and miserable. To destroy the power of these creators, and to free man from the power of matter, God sent the most exalted of all æons, to which character Simon first made pretension: he was followed in these pretensions by Menander, a Samaritan, the most celebrated of his scholars, who, toward the end of the 1st century, founded a sect at Antioch in Syria. Simon and Menander were enemies to Christianity. Cerinthus, a Jew, of whom John the Evangelist seems to have had some knowledge, combined these reveries with the doctrines of Christianity, and maintained that the most elevated æon, sent by God for the salvation of man, was Christ, who had descended upon Jesus, a Jew, in the form of a dove, and through him revealed the doctrines of Christianity. In the 2d century, during the reign of Hadrian and both the Antonines, these principles were adopted by certain Christian philosophers, who are more particularly known under the name of Gnostics, and still further refined, extended, and systematized. Saturninus, a Syrian, speaks of an unknown supreme God, who had generated many angels and powers; seven of these æons were, according to him, creators of the world, and soon fell from God; one of them, the God of the Jews, had seduced man to him, whence originated the difference between good and bad men. Saturninus also calls Christ the Saviour sent by God, and the Son of God; but the opinion that Christ was not actually born, and had not a real human body, but only an incorporeal image, is peculiar to him, on which account his followers and other later Gnostics who agreed with him in this respect were called *Docetæ* (from Greek δοκεῖν, to seem) and *Phantasiasts.* The system of Carpocrates, an Alexandrian, who also flourished during the reign of Hadrian, was distinguished from the one which we have just described in this respect only, that he considered Christ as a mere man, whose purer and more powerful soul had more accurately remembered what it had seen with God before its union with the body. The fathers of the Church, Clement of Alexandria, Irenæus, Eusebius and Epiphanius, from whom, in general, we derive all our information concerning the Gnostics, accuse the moral system of Carpocrates of destroying all distinctions between good and evil, and inculcating an unlimited indulgence of the sensual appetites. Certain it is that his followers practised the most detestable vices, and were the cause of many of the calumnies of the heathen writers concerning the Christians of this century. The Valentinian party, which rose toward the middle of the 2d century in Rome, and especially in Cyprus, and which was distinguished by its austere manners, was the most numerous of all the Gnostic sects, and continued until after the commencement of the 4th century. Marcion of Sinope, and Cerdo, a Syrian, renounced many of the absurdities of the earlier Gnostics, and formed a regular system, the characteristic of which was the rejection of the Old Testament. Bardesanes, a Syrian, and Hermogenes, an African, who, in the reign of the Emperor Commodus, apostatized from Christianity and established sects, bordered, in their hypotheses concerning the origin of good and evil, upon Gnosticism. On the whole, when we take into consideration the philosophical tendency of that age, the passion for the marvelous that had taken possession of the effeminate nations of the Roman empire, and the custom of pretending to a deeper insight into the secrets of nature and the divinity, it is not to be wondered at that a religious philosophy which adopted the most brilliant parts of Platonism, and which afforded nourishment alike to the imagination and to the vanity of secret wisdom, should have met with such universal success. By the austerity of its precepts, and its care for the well being of the soul, it even prepossessed good men in its favor. The Gnostics were the Pietists of the 3d and 4th centuries. The Roman Catholic Church took

occasion from their heresy to give greater precision to the articles of the orthodox faith. There have been no Gnostic sects since the 5th century; but many of the principles of their system of emanations reappear in later philosophical systems, drawn from the same sources as theirs. Plato's lively representation had given to the idea of the Godhead something substantial, which the Gnostics transferred to their æons; and Leibnitz's 'Effulgurations of God,' Ploucquet's 'Real Presentations of God,' St. Martin's 'Pictures and Mirrors,' and the like, as well as the Gnostic æons, are a proof that the essays of the human understanding to explain the creation and the origin of imperfect beings from the perfect always end in similar results. See GNOSTICISM.

Gnu, nū, a Hottentot name of one of the two species of wildebeest. The wildebeests are African antelopes, forming the genus *Connochetes.* The white-tailed gnu or "horned horse" (*C. gnu*) resembles, in form, partly the horse, partly the buffalo, and partly the stag. It is as large as a middle-sized horse, and its neck is adorned with a stiff erect mane. On the forehead the face is covered with an oblong tuft of stiff black hairs, turned upward. Beneath the lower jaw is also a thick, shaggy beard. The legs are long, and elegantly formed, like those of the stag; the space between the fore-legs is covered with long bushy hair. The tail is long and white. The horns are rough, and are enlarged at their base like those of the buffalo; they spring from the hinder part of the head, and, after bending forward beyond the eye, turn suddenly upward. Both sexes are furnished with these appendages. In the young animal they are perfectly straight, acquiring their flexure as the animal grows older. The gnu is affected by the sight of scarlet, like the buffalo or bull. When irritated, it expresses its resentment by plunging, curveting, tearing the ground with its hoofs, and butting with its head. The flesh is juicy, agreeable, and nourishing. This animal was formerly widespread and numerous, roving in small bands with zebras, etc.; but it is now nearly or quite extinct.

Another species, whose habitat was north of the Zambesi, has still escaped extirpation in the interior. It is named *C. taurina,* and has no long hair in front between the fore-legs; there are dark stripes on the sides, and the tail is shorter and black. Consult: Bryden, 'Nature and Sport in South Africa' (London 1897); Millais, 'A Breath from the Veldt' (1895); and the writings of South African sportsmen travelers from Gordon-Cumming (1850) onward.

Goa, a Tibetan gazelle.

Goa Powder, a substance found in the wood of the *Andira araroba,* a leguminous tree growing in Brazil and the West Indies. It derives its name from Goa, a Portuguese colony on the southwest coast of British India, to which it was imported from Bahia for the first time in 1852. It has a bitter taste, is considered efficacious in certain skin diseases, and is used in the preparation of chrysarobin.

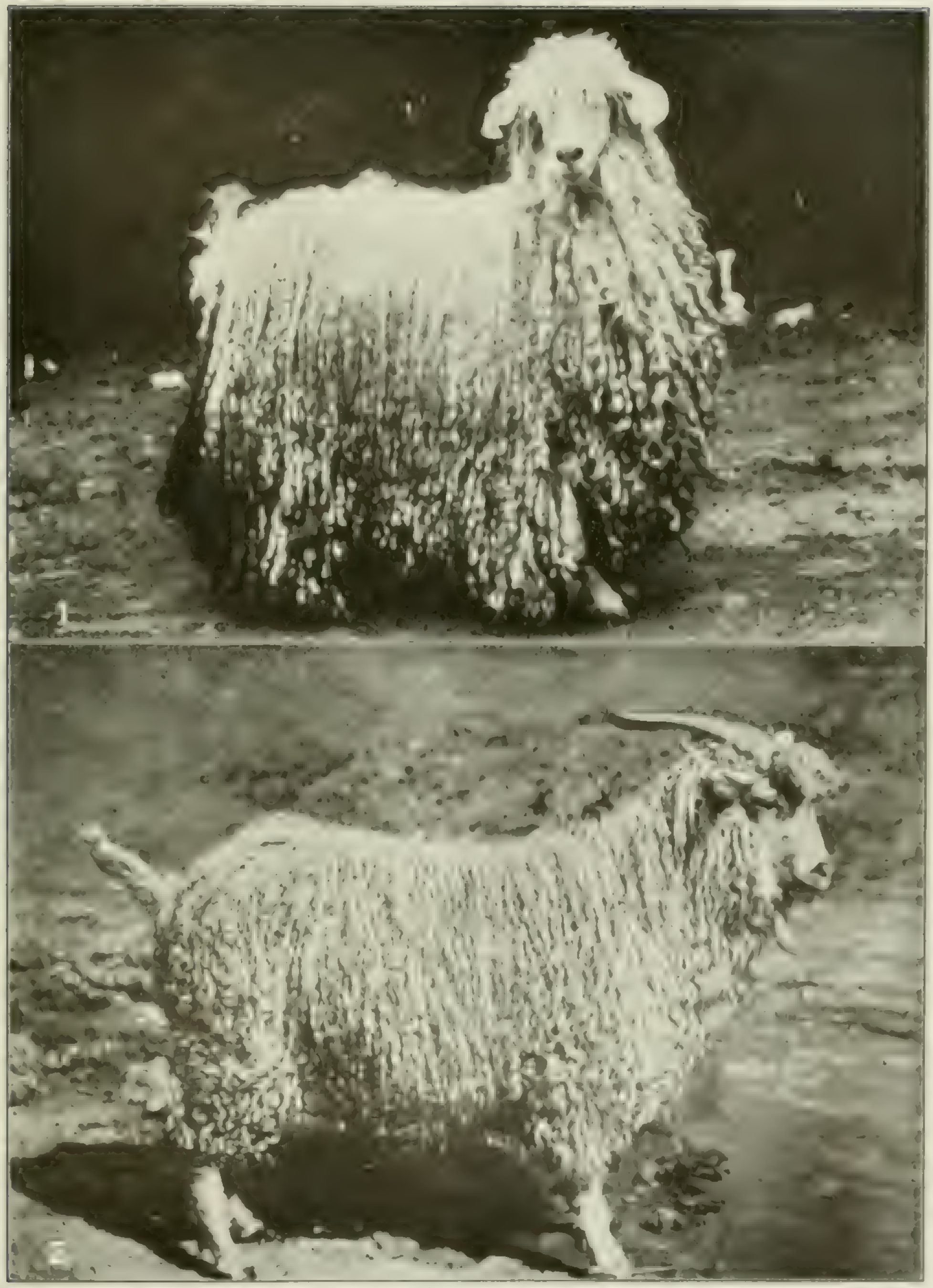
Goajira, gō-ä-hē'rä, a peninsula in Colombia, which forms the most northerly point of South America. It lies west from the Gulf of Maracaibo, or Venezuela, and runs northeast from the Sierra Nevada de Santa Marta to the volcanic Sierra Macuira, which forms its apex, rising to a height of 2,800 feet. The coast is edged with sandbanks, but there is good anchorage at Bahia Honda. Its exports are dyewood, dividivi, pearls, and wood for cabinet work. Up to 1891 Venezuela laid claim to the peninsula, which in that year was formally ceded to Colombia.

Goajiros, gō-ä-hē'rōs, an Indian tribe inhabiting the peninsula of Goajira (q.v.). They are reckoned at 25,000 souls, are subdivided into numberless septs or clans, and for the most part are nomadic, but cultivate the soil and keep flocks and herds (sheep, goats, horned cattle, horses and asses). They also trade in dividivi and fine woods. They are good horsemen, and warriors, arming themselves with bow and poisoned arrows, and are also expert in the use of firearms. They are of fine physical build, especially the women, who are held in high esteem. They wear little clothing, but paint their bodies, and love fine harnesses for their horses. The Roman Catholic mission has been very successful in evangelizing them. Their language is a branch of the Arowak and Maipure group, and connects them ethnologically with the aborigines of the Bolivian Andes, and the plains of the Mahaica and Surinam rivers.

Goat. There is probably no other species of domestic animal that is so widely distributed over the earth as the goat, not excepting the horse, or the cow, or the sheep, yet there is none of them concerning which we have so little scientific information. We are told, however, that there are 10 species of wild goats, all but one of which (the Rocky Mountain goat) are confined to Europe and the Himalaya Mountains. These 10 species are divided into two groups — the ibexes and the goats proper. The ibexes are composed of two sub-species — *Capra falconeri* and *Capra ægagrus.* The *C. ægagrus* is the Paseng, or Bezoar goat, or wild goat, of Persia, and is the progenitor of *C. hircus,* through which are descended all of the domestic goats of all countries. These are numerous in kind and variable in characteristics. Of these only the Angora and the Cashmere breeds and the several breeds of milch goats are of special economic importance, and these only will be treated here.

The Angora Goat.—The history and development of the Angora goat can not be traced to the beginning, but there is evidence that it belonged to a distinctive breed even in the days of Abraham. So far as can be stated definitely at this time, this breed is a native of the vilayet of Angora, in Asia Minor. The capital of the vilayet is Angora, or Eugurieh, the ancient city of Ancyra, where it is believed that the Apostle Paul established one of the western Christian Churches.

The geographical distribution of this breed is not extensive, their raising as an industry being confined to Turkey in Asia, South Africa, and the United States. They have been transplanted to many of the European countries, but without successful result. Australia has had a small number for 50 years, but it is only at the present time that a strong effort is being made to build up an industry of importance there.



1. ANGORA GOAT—YOUNG DOE

2. ANGORA GOAT—BUCK

A few Angoras are thriving in Canada and experiments are being conducted with them in Porto Rico and Cuba. Approximately stated, there are 3,700,000 of these goats in Turkey, 5,000,000 in South Africa, and 800,000 in the United States. At this time they may be found in every State and Territory, including Alaska.

Angoras were introduced into the United States from Asia Minor in 1849 by Dr. James B. Davis, of Columbia, S. C. There were nine goats in this importation, and at that time and for several years later they were regarded as belonging to the Cashmere breed, but one only was a Cashmere, while the remaining eight were Angoras. Several other importations, usually in small lots, have been made from Asia Minor and South Africa. For ten years previous to the outbreak of the Civil War considerable effort was made to exploit the proposed new addition to the animal husbandry of the country, but this failed for various causes, and for many years after the war it seemed that the Angora goats were to prove an absolute failure here. The war had scattered or destroyed nearly all that were in the Eastern and Southern States, but a few that had found their way to California and the Southwest increased rapidly in numbers by crossing upon the long-haired Mexican goats. The redivivus of the industry came about the year 1900, when it was discovered that this country not only had the mills to consume all of the mohair of domestic production, but was also importing over a million pounds annually. The organization in the same year of the breeders into a registry and fair association gave to the industry its first impetus; and then the government assisted largely in exploiting the qualities of the animals. About this time, too, the ability of goats for destroying brushwood became widely known. These two leading features have tended to bring about a rapid growth of the industry.

The Angora goat is small, weighing generally from 60 to 100 pounds, although many may be found in the United States that weigh as much as 140 pounds, and occasionally one much heavier than this. Males and females alike have horns and beards, except that in rare instances one without horns may be seen. The horns of the male grow to a length of 18 to 20 inches and turn upward, outward, and backward, while those of the female, which grow to a length of 8 to 10 inches, grow upward and point backward with only a slight inclination to twist. The ears are usually medium long and pendant, but there are frequent specimens having ears that are short, pointed, and pricked. Except in rare instances, the fleece is pure white, growing to an annual length of 10 inches and covering the entire body down to the knees and hocks. There is no goat odor with this breed except with the bucks at rutting time. The Angora usually has one kid at a birth; twins are not uncommon, and threes are seldom dropped.

The uses of the Angora goat in the United States are three: (1) For the production of mohair (see MOHAIR); (2) for the production of meat; and (3) for the destruction of brushwood and weeds. It is used rarely as a milch animal, owing to the uncertain quantity of milk which it yields.

The uses of mohair are many already and new ones are being invented frequently, so that there has been a constant and increasing demand for this product, with no indication that the supply will ever equal the demand. [illegible] under the head of MOHAIR. The natural result of the many uses of this staple has been an increase in the number of goats and the breeding of animals of better quality. The average weight of the fleece at this time is about 4 pounds, but there are many animals of exceptional merit that will yield 12 pounds and even more, and occasionally a flock that will average 8 pounds per head. A few more years of careful breeding will very likely increase the average per head for the whole country to 5 or 6 pounds. Within the last four or five years, during which time there has been intelligent effort made to increase the quantity of the fleece, there has been marked improvement, and the weight of the average fleece has probably gained 40 per cent. The future should show even better results. The goats yield heavier fleeces in the colder parts of the country than in the warmer sections, and those animals taken from the southwestern States to the northern part of the United States show an increase the first year.

The Angora is the only one of the numerous breeds of goats that yields a carcass that is edible at all ages. The Angora kids, like those of other breeds of goats, are considered a delicacy, and the mature animal is free from the strong taste that is characteristic of other breeds. The size, shape, and quality of the Angora carcass make it so resemble that of the sheep that the packers slaughter large numbers of the low grade Angoras and sell them as sheep mutton. A peculiarity of Angora mutton is that it requires a longer time for cooking than does sheep mutton. In the southwestern part of the country, especially on the large ranches, where it is difficult to keep meat fresh, many grade Angoras are slaughtered for food; but in other parts of the country, where the animals are usually of high grade, they are not generally slaughtered, being regarded as of more value for mohair production.

The predilection of goats for brushwood and weeds is characteristic of all breeds, but the Angoras are considered preferable for this use, because they are able to produce a marketable fleece at the same time they are clearing the land. In many parts of the United States they are regarded as of more value for clearing brushland than any other means. This is especially true where the land is wanted for [illegible] orchards. The total area of land so cleared of brushwood by these goats [illegible] thousands of acres, and their work is done in a most satisfactory manner. The goats feed on every twig and leaf within their reach, [illegible] standing on their hind legs, [illegible] will peel the bark from the [illegible]. If they are again placed on land the second year, so that they may destroy the sprouts that put out from the stumps, their work will be completed, for the stumps and roots then die. As the brushwood and weeds are destroyed [illegible] the grass, [illegible] is indigenous to the locality, will

observed to spring up and thereupon spread rapidly. Where a good variety is not indigenous, a common practice is to sow the seed. This method insures a grass pasture sooner than depending upon the natural grasses and their natural distribution over the cleared area. The goats prefer browsing upon the brushwood to feeding upon the most luscious grasses and clovers and will give the latter very little attention if there is enough of the former to satisfy their hunger. Their presence upon the soil and their indirect assistance in producing the pasture do not make the grass objectionable in any way to horses, cattle or sheep. It should be stated, however, that goats will thrive upon grass and clover if it becomes necessary, and there is no better rough feed for them in winter than clover hay.

The Cashmere goat flourishes in Kashmir, in India, whence it receives its name, and in Tibet. Its color is usually white, and in many other ways it resembles the Angora; but its heavier and outer coat is coarse and not of economic value. Its under coat, called pashm, is very fine and light in weight, and brings very high prices. The amount of pashm produced by each goat annually is between two and three ounces. Most of this fibre is secured by combing the animals when it loosens from the skin, but a considerable amount is picked from the bushes where the animals have rubbed in an effort to remove the sloughing hair. The famous Cashmere shawls, which, a half century and more ago sold at $100 to $2,000, were made of pashm. Dr. Davis brought one Cashmere doe to the United States with his Angora flock in 1849; a buck of this breed died on the voyage. Nine others came in the Brewer importation about 1858. The Cashmeres appeared not to be able to survive the climatic conditions to which they were subjected here, and at this time there is probably not a single specimen in this country. It is not known to the public whether any pashm finds its way to America in the raw state, but it is not likely that it does.

Milch Goats.—No one has attempted to state how many breeds of milch goats there are in the world; one writer says that there are no less than 16 in Switzerland. They are found in their pure state in all European and Asiatic countries and in several of the countries of northern Africa. Specimens of good milking qualities are numerous in South Africa and Australasia, and a very few may be found in the United States. Probably the deepest milker among all breeds is the Nubian, but it is suited to very warm climates only. With reference to their adaptability to our climate and soil, the following are probably of about equal merit: Toggenburg and Saanen of Switzerland, Maltese of Malta, and the Syrian of Palestine. Nearly all of the Swiss breeds are excellent, and also some of those of France and Spain.

In May 1904 there was an importation of 26 Toggenburg and Saanen goats into the United States, and at this time they are thriving well in Massachusetts, New York, New Jersey, and Maryland. So far as any records show, these are the only goats of pure blood that have been received, except four that came in 1893, which did not thrive well; but it is believed that a few kids of Italian goats have been brought here by immigrant families from Italy, and that these have matured and been crossed with the common goats that are usually found in the suburbs of the large cities, thus lending something of their milk characteristics to these latter goats. It is not difficult to find good milkers among these common goats.

A good milch goat should have the same leading characteristics that are possessed by a milch cow. The goat should be level on the back, with slightly dropping hips; the hair, whether long or short, should be kept trimmed close on the udder; the udder should have a shriveled appearance immediately after milking, and the teats should be long and slim.

Milch goats are prolific, seldom having fewer than two kids at a birth, and sometimes four of them. If not restrained they will breed three times in two years.

The quantity of milk that they give varies; a goat that will give two quarts of milk daily for six months is a good milker, but there are many of the best breeds that will yield four quarts a day with a lactation period of six to nine months. Thus it will be seen that, when body weight is considered, the goat is a larger producer of milk than the cow. The milk has a slightly different taste from that of the cow; the strong, acrid taste so often noted by those who have drunk it is due to unclean methods of milking. If the milk is drawn perfectly clean and kept clean, it does not have either taste or smell that is offensive. It is highly regarded in the Old World for its health-giving properties and as a food for children. It is used quite largely in the hospitals in the Swiss and French Alps for tuberculous patients and for those suffering from stomach troubles. The advocates of a milch goat industry in the United States base their arguments principally upon the healthfulness of the milk, although a large use of the goats by the poor in the suburbs of the great cities and in mining districts, it is believed, would prove very economical as well as healthful. Tuberculosis is seldom found in goats, and therefore the germs of the disease, which may be found in the milk of a very large percentage of cows, has never been reported in goat's milk. This fact gives to this milk its highest recommendation.

Kids that are not to be kept for breeding are disposed of for slaughter, and there is a good demand for them among certain classes in the large cities. The flesh is exceedingly delicate, and nothing but the prejudice of people against a matter which they have not tested prevents a larger production and consumption of kids. The kids should be from one to two months old when slaughtered, as after two months the flesh begins to grow tougher and stronger.

Common Goats.—According to the census report of 1900, there are over 1,000,000 common goats — that is, goats of no special line of breeding — in the United States. They can hardly be referred to as an industry, for they have thrived and increased in numbers in spite of neglect. They have been useful in an incidental manner only. A considerable number are used as pets for children, and occasionally a fair milker is found among them. Since the Angoras have demonstrated the ability of the goat to destroy brushwood, the common goats have been brought together in flocks in some

localities and there employed also as brush destroyers. The greater number of common goats are simply tolerated.

Goat-skins.— During the fiscal year of 1904 the United States paid to foreign countries $25,962,620 for goat-skins, not including $4,030,213 paid for gloves, a large part of which was for kid gloves. These importations have been increasing in value annually because of the increased use of goat-skin leather in this country. These imports come chiefly from British India, Mexico, Germany, Russia, and Brazil. With this large expenditure for goat-skins, many persons have thought that the goat-skin industry ought to be developed in the United States, since we have here all that is desirable in the way of climatic, soil, and market conditions; but a recent investigation by an authority in the government service shows that the United States can not compete for this business, for the reason that in all of the countries where the skins are produced in large quantities the wages of goat-herds is a mere pittance, and the carcass, however poor, is consumed for food. These two features preclude a goat-skin industry in this country. However, in connection with the milch goat industry there will be a considerable number of skins, and the prices paid are large enough to pay for caring for them. Goat-skins are used in the manufacture of shoes, gloves, music rolls, morocco for book bindings, etc. The skin of the Angora goat is used as rugs and robes with the hair intact, and also for children's muffs, capes, and for boas for ladies. The leather, like that from all skins having long hair, is not suitable for shoes or fine gloves, but is used largely for workmen's gloves and morocco.

The government, through the Department of Agriculture, has been lending encouragement to the goat industry in all its phases, and its publications on this subject are sent free to all applicants.

George Fayette Thompson,
Bureau of Animal Industry, Washington, D. C.

Goat-antelope, a term applied to certain small mountain-climbing ruminants, which in structure and habits are intermediate between typical goats and antelopes. Such are the white goat of the Rocky Mountains; the chamois of Europe; and the gorals, serows, etc., of the Himalayan and other Oriental mountain regions. For description see their English names.

Goat-fish, one of the gaudy and edible fishes, allied to the surmullets, of the genus *Upeneus*, which abound in the West Indies and Gulf of Mexico, and take their popular name from a fancied likeness of their bearded profile to a goat's. There are several species. The English sometimes call their filefish (q.v.) by this name.

Goat Island, (1) an island in the Niagara River which separates the Horseshoe and American falls. (2) A large island in San Francisco Bay, where there is a lighthouse and government station.

Goat-louse, a parasite living in the hair of goats. It is a biting louse of the genus *Trichodectes*, and that which infests the Angora goat (*T. limbatus*) is often troublesome. Various species occur in various parts of the world.

Goat-moth, a large European malodorous moth (*Cossus ligniperda*), whose caterpillar, the "auger-worm," feeds upon decayed wood, boring a tunnel at the end of which, after three years of growth, it forms a cocoon of chips gummed together by a secretion, and transforms within it.

Goatsbeard, a small rosaceous plant of American woodlands (*Aruncus aruncus*), closely allied to spiræa, with minute white flowers in dense panicles blooming in June, in rich woods of the Mississippi valley, and also on the northern Pacific coast and in Europe and Asia. The name is also given to a saxifrage (*Astilbe biternata*), and to dandelions of the genus *Adopogon* and some other plants.

Goatsuckers, a family of birds, defined under *Caprimulgidæ*, so erroneously named that the term should be abandoned. See NIGHTJAR; NIGHTHAWK; WHIPPOORWILL, etc.

Gobat, gō-bä', **Samuel**, English missionary: b. Bern, Switzerland, 26 Jan. 1799; d. Jerusalem 12 May 1879. After completing a course in Oriental languages in the Mission House at Basel, he became a missionary, going to Abyssinia in 1826 for the English Church Missionary Society. In 1829 he had reached Gondar, but in 1832, upon the outbreak of war in that part of the country, he returned to England. In 1834 he made another journey to the same country, but owing to illness again had to go home. In 1839 he was sent to Malta, where he translated the Bible into Arabic, and in 1845 was appointed a director of the Protestant College. In 1846 Friedrich Wilhelm IV. of Prussia placed him in charge of the See of Jerusalem, an appointment which he held until his death. It was in the orphan schools and hospitals of Jerusalem, Nazareth, and other cities of Palestine that he did his greatest missionary work. He wrote: 'A Journal of Three Years in Abyssinia' (1834).

Gobelin (gŏb-lăṅ) **Manufactory**, a tapestry manufactory at Paris, established by Colbert in 1667. The Gobelin tapestries excel everything of the kind in Europe. Many celebrated paintings of the Italian, French, and Spanish schools have, in the most marvelous manner, been transferred to tapestry. Among the more celebrated of these may be mentioned the portrait of Louis XIV., by Rigaud (the original of which is in the Louvre); 'The Assumption' of Titian, a large work, 23 feet in height; a head by Nicholas Poussin, executed by Marie Gilbert, etc. The first two of these are to be seen in the Gobelin Gallery. All are characterized by splendor of coloring and delicacy of execution. The establishment is now carried on at the expense of the government.

Gobi, gō'bē, **Desert of**, China, the Shamo, or "sand-sea" of the Chinese, an immense tract of desert country, occupying nearly the centre of the high tableland of eastern Asia, between lat. 35° and 45° N., and lon. 90° and 110° E., and extending over a large portion of Mongolia and Chinese Turkestan. Its length is probably about 1,800 miles; mean breadth, between 350 and 400 miles; area, 300,000 square miles. Its general elevation is over 4,000 feet above sea-level. The East Gobi is occupied by different tribes of the Mongolian race, who have numer-

ous herds of camels, horses, and sheep. In the West Gobi are some nomadic tribes of the Tartar race. This tract is supposed at one time to have been a great inland sea.

Gobin, Hillary Asbury, American educator: b. Terre Haute, Ind., 25 March 1842. In 1862–5 he was in the Union army, was graduated from Indiana Asbury College (the present De Pauw University) in 1870, was admitted a licensed preacher of the Northwest Indiana conference of the Methodist Episcopal Church, and held various pastorates in Indiana. In 1880–6 he was professor of the Greek language and literature at De Pauw, in 1886–90 president of Baker University (Baldwin, Kan.), in 1890 became dean of the theological faculty at De Pauw. He was elected president of De Pauw in 1896. His writings comprise articles and reviews in religious and secular periodicals.

Gobineau, gō-bē-nō', **Joseph Arthur, Count de,** French diplomat and author: b. Bordeaux 1816; d. Paris 17 Oct. 1882. He served in the French diplomatic corps in the various capitals of Europe, at Athens in 1868, at Rio Janeiro, South America, and at Stockholm. Chief among his writings are: 'Troi ans en Asie' (1859); 'Les religiones et les philosophies dans l'Asie centrale' (1865); 'Historie des Perses' (1869), etc.

Goblet, gō-blā', **Albert Joseph,** Belgian soldier and statesman: b. Tournai 1790; d. 1873. He participated in the battle of Waterloo, and after the Revolution became minister of war, remaining in that position until he was made minister of foreign affairs in 1832. In 1837 he was appointed ambassador of Spain, a post he held for two years, and it was then that the title of Count d'Alviella was bestowed upon him by the Queen of Spain. In 1843 he was again appointed minister of foreign affairs and for two years in this capacity, his influence on all public matters was felt to a marked degree. He also planned the fortifications along the frontier of northern Belgium, and extended those already built around Antwerp. He wrote: 'Des cinq grandes puissances de l'Europe dans leurs rapports politiques et militaires avec la Belgique' (1863); 'Dix-huit mois de politique' (1865), etc.

Goblet, D'Alviella, Eugène, Count, Belgian archæologist and religious historian; b. 1846. He became professor of the history of religions at the University of Brussels, afterward being elected a Liberal member of the Belgian Chamber of Deputies. In 1892 he was elected to the Senate. After traveling through the Sahara Desert he began his writings, the more important of which are: 'Sahara and Lapland' (1875); 'Inde et Himalaya'; 'The Contemporary Evolution of Religious Thought in England, America, and India' (1885); 'The Migration of Symbols' (1894); and 'Ceque l'Inde doit à la Grèce' (1897).

Goblet, René, rĕ-nā gō-blā, French statesman: b. Aire-sur-la-Lys, 26 Nov. 1828; d. Paris, 13 Sept. 1905. He practised law at Amiens, and entering in 1871 the National Assembly, identified himself with the left Republican group, and became known as an orator, particularly through his part in the discussion respecting the revision of the pension-list for officials under the empire. In 1882 he became minister of the interior, in 1884 of education, and in 1885 of education and public worship. Prime minister in 1886–7, he was minister of foreign affairs in 1888–9, was elected senator in 1891, and sat in the Chamber of Deputies as a Radical in 1893–6.

Goby, gō'bĭ, any one of the 400 species of fishes belonging to the family *Gobiidæ*. They are small carnivorous animals, occurring chiefly on the bottoms of tropical seas and ponds. Most of the species have the ventral fins united into a sucking disk. Most interesting of the gobies are the mud-skippers (*Periophthalmus*) of the western Pacific, which hop about the shores by aid of their pectoral fins, feeding upon insects and naked mollusks. Many of the gobies make nests for their eggs.

God, the Supreme Being, the First Cause, and as considered nowadays throughout the civilized world, a spiritual being, self-existent, eternal and absolutely free and all-powerful, distinct from the matter which he has created in many forms, and which he conserves and controls.

There does not seem to have been a period of history where mankind was without belief in a supernatural author and governor of the universe. The most savage nations have some rudimentary ideas of God. Man is a religious as well as a rational animal. The instinct of belief in God is asserted by philosophical theists to be reconcilable with reason, although no competent apologist now stakes the existence of God on any one argument, or exhibits the proof as a series of syllogisms. It is rather maintained that the study of human history, of human nature especially on its moral and spiritual side, and of the world as far as science reveals it to us make for the existence of a God, demand such a postulate as the key to the universe, and render the belief in a personal God greatly more probable than any other thesis — a subject vastly too wide for discussion here. But it is necessary to name what are often referred to as the four great arguments for the existence of God.

(1) The *ontological* argument first formulated by St. Anselm proceeds from the notion of a most perfect being to infer his existence; without actual existence the idea would fall short of perfection. The argument was re-stated in a different shape by Descartes (q.v.) and by Samuel Clarke, and, though very contemptuously treated by Kant, is still an element of the argument that without a God the world is a chaos.

(2) The *cosmological* argument, employed by Aristotle, Aquinas, and a host of Christian authors, is an application of the principle of Causality (q.v.). We cannot conceive an infinite regression of finite causes; therefore beyond the last or first of the finite causes is the Infinite. From motion the argument is to a mover.

(3) The *teleological* argument, or argument from design, proceeds from the order and arrangement of the universe, the reign of law and beauty and adaptation, to the intelligent and supreme fountain of order. This is the most familiar of the arguments, especially on the lines laid down by Paley.

(4) The *moral* argument was that relied on by Kant (q.v.) when he destructively criticised the other three, and forms a part of most modern theistic arguments. God is a postulate of our

moral nature: and the moral law in us implies a lawgiver without us.

Consult: Flint, 'Theism' (1877); Harris, 'The Philosophical Basis of Theism' (1883); 'The Grounds of Theistic and Christian Belief' (1883); the Duke of Argyll, 'The Reign of Law' (1890); Kant's 'Critique of Pure Reason'; Mill's 'Three Essays'; Janet's 'Final Causes' (trans. 1878); Gifford Lectures (1888); Romayne, 'God, Knowable and Known' (1888); Driscoll, 'Christian Philosophy — God' (1902).

God, Name of, in Different Languages, may be seen from the following list: Elohim, Hebrew; Gott, Swiss and German; Eilah, Chaldaic; Goed, Flemish; Eleah, Assyrian; Godt, Dutch; Alah, Turkish and Syriac; Alla, Malay; Goth, Teutonic; Allah, Arabic; Gude, Danish and Swedish; Teut, old Egyptian; Teun, new Egyptian; Gude, Norwegian; Teuti, Armarian; Bogo, Polish; Theos, Greek; Bung, Pollacca; Jubinat, Lapp; Sire, Persian; Magatal, Tartar; Deus, Latin; Diex, Latin, low; Diu, Gallic; Dieu, French; Dios, Spanish; Deos, Portuguese; Diet, old German; Dieu, Provençal; Doue, low Breton; Dio, Italian; Dia, Irish; Deu, Olala tongue; Theos, Cretan; Jumala, Finch; As, Runic; Fetiyo, Zemblian; Istu, Pannonian; Rain, Hindostanee; Brama, Coromandel; Prussa, Chinese; Goezur, Japanese; Zannah, Madagascar; Puchecammac, Peruvian.

God Save the King (or **Queen**), the burden and common title of the English national anthem. Concerning the author and the composer opinions differ. It has been asserted that Henry Carey, who lived about the middle of the 18th century, was both; but, being ignorant of the rules of composition, employed Dr. Thornton, of Bath, or, according to some, Christopher Smith, Handel's clerk, to correct his rough draught, and add the bass. This story gave rise to the assertion that Handel was the composer. It appears to have been first published, together with the air, in the 'Gentleman's Magazine' in 1745, when the landing of the young Stuart called forth expressions of loyalty from the adherents of the reigning family. After Dr. Arne, the composer of "Rule Britannia," had brought it on the stage, it became very popular. According to a notice in the 'New Monthly Magazine,' Vol. IV. page 389, there is a copy of this national song, published without date by Riley and Williams, in which Antony Young, organist in London, is called the author of the air. There is also a story that this national song, as Burney, the author of the 'History of Music,' mentioned, was not made for King George; but that, in the older versions, it ran thus, "God save great James our king"; and Burney adds, that it was originally written and set to music for the chapel of James II., but that no one dared own or sing it after the abdication of James, so that the song lay dormant 60 years before it was revived for George II. Another account ascribes the air to John Bull, who was organist to the chapel of Queen Elizabeth in the last years of her reign.

Godavari, gō-dä'va-rē, a large river in India. Its source is in the Western Ghauts, about 70 miles northeast of Bombay, and flows southeast into the Bay of Bengal. About 50 miles from the sea the river divides into two channels, the most northern of which flows into Coringa Bay. In the rainy season these branches are navigable, but only for small craft. Before the river divides there are three great obstacles to navigation, caused by three rocky barriers. Between 1861 and 1871 large sums of money were expended by the government on an attempt to open up the navigation of the river by canals going round these barriers, but finally the project was abandoned as involving too great an expenditure.

God'dard, Calvin Luther, American inventor: b. Covington, N. J., 22 Jan. 1820. He was graduated from Yale in 1845 and subsequently devoted his attention to the invention of labor-saving contrivances employed in the wool industry. Among his various inventions of this character may be cited feed rolls for carding machines, a burring picker for the purpose of cleansing wool, and solid packing burring machines.

Goderich, gōd'rĭch, Canada, capital of Huron County, Ontario, port of entry, on Lake Huron at the mouth of the Maitland River, and the terminus of a branch of the Grand Trunk Railway; 119 miles west-northwest of Hamilton, 125 miles west of Toronto. It has a good harbor, steamship lines to various ports, and its people trade largely in fish, salt, and lumber. It is in a good farming district, lumbering and boat-building are important industries, its fisheries are extensive, and large salt-wells make salt refining its chief industry. There are also manufactories of foundry products, machinery, woolens, leather, boots and shoes, wooden ware, etc.; flour and saw mills; and large grain elevators. Pop. (1901) 4,158.

Godet, Frédéric, frā-dē-rēk gō-dā, Swiss theologian: b. Neuchâtel, Switzerland, 25 Oct. 1812; d. 1900. After having been tutor to the crown prince of Prussia, he became in 1850 professor of theology at Neuchâtel. In 1873 he left the state Church and was appointed professor by the Free Church of Neuchâtel. He is best known for his great commentary on St. John's Gospel (1863–5; Eng. trans. 1877), followed by commentaries on Luke (trans. 1875), Romans (trans. 1881), and Corinthians, besides 'Conférences Apologétiques'; 'Études Bibliques' (trans. as 'Old Testament Studies and New Testament Studies' 1875–6); 'Introduction to Paul's Epistles' (1893).

Go'dey, Louis Antoine, American publisher: b. New York 6 June 1804; d. Philadelphia 29 Nov. 1878. He founded the periodical 'Godey's Lady's Book,' the first of the kind in the United States, at Philadelphia, in 1830, and continued its editor and proprietor until its sale to a stock company in 1877. His other publications included 'Jarvis' Musical Library,' and the *Daily Chronicle.*

Godfather and **Godmother** (also, in infant baptism, called sponsors), the persons who, by presenting a child for the sacrament of baptism, and taking upon themselves the vows of faith and obedience, as proxies for the child, and in the name of the child, are reputed to contract toward the newly baptized the relation of spiritual parentage. In the Roman Catholic Church this spiritual relationship is regarded as a species of kindred (whence the name gossip or Godsib, "spiritually akin"), and constitutes an impediment of marriage between the sponsors upon the one hand and the baptized and the parents of the baptized on the other. Anciently,

this impediment arose between the sponsors themselves; and it still extends much further in the Eastern than in the Western Church, although in the former it can arise only from baptism, whereas in the Roman Church the candidate for confirmation also is presented by a sponsor, though usually one of the same sex.

In the Church of England, by whose rule two godfathers and a godmother are required at the baptism of a male, and two godmothers and a godfather at that of a female, no impediment of marriage arises from the relation of the sponsors to the baptized. The parents of the baptized are not permitted to act as sponsors in the Roman Catholic Church, one of the objects of the institution being to provide instructors in case of the death of parents; but the rubric of the American Prayer-book does so allow.

The institution of sponsors was very ancient, and Tertullian (192 A.D.) speaks of the promises made by sponsors in baptism. In the early Church no more than one sponsor was required, a man for a man and a woman for a woman. In adult baptism, the godfathers and godmothers are not sponsors, but only "chosen witnesses," as the person to be baptized takes the vows himself and in his own name.

Godfrey, Elizabeth. See BEDFORD, JESSIE.

God'frey, Thomas, American poet: b. Philadelphia, Pa., 4 Dec. 1736; d. near Wilmington, N. C., 3 Aug. 1763. He is remembered as being the author of 'The Prince of Parthia' (1759), a tragedy, considered to be the first drama published in the United States. In 1763 appeared 'The Court of Fancy; a Poem,' and in 1767 his poems were collected in a volume by his friend, Nathaniel Evans.

Godfrey, Thomas, American mathematician and mechanician: b. Philadelphia 1704; d. December 1749. He was a glazier in his native city; but accidentally meeting with a mathematical treatise, was delighted with the study, mastered all the books on the subject that he could obtain, and instructed himself in Latin in order to read mathematical works in that language. He borrowed a copy of Newton's 'Principia' from James Logan, secretary of the commonwealth, and in 1730 communicated to him an improvement that he had made in the quadrant. In 1732 Logan gave an account of the invention to Dr. Edmund Halley, of England. in a letter. No answer was received after an interval of a year and a half, and then the invention of Godfrey was laid before the Royal Society by the botanist Peter Collinson. Meantime, in 1731, Halley had presented a paper containing a full description of an improvement of the quadrant similar to that of Godfrey. The rival claims were investigated by the Royal Society, and it was decided that they were both entitled to the honor of the invention, and a reward of £200 was bestowed on Godfrey. Franklin observed of Godfrey that, like most great mathematicians whom he had met, he was not a pleasant companion, since he expected universal precision in everything said, and was perpetually denying or distinguishing on trifles, to the disturbance of all conversation.

Godfrey of Bouillon, boo-yôṅ, king of Jerusalem: b. Baisy, in the Walloon Brabant, near Nivelles, 1061; d. Jerusalem 15 July 1100. In 1076 he succeeded his uncle in the duchy of Bouillon. He distinguished himself by his heroic courage at the siege of Rome, and the fame of his exploits procured him, in 1095, the command of one of the armies of the first crusade. In 1096 Godfrey, with his brothers Baldwin and Eustace, commenced his march to Constantinople, the meeting-place of the crusading armies. So great had been the difficulties of the way that it was only a short time before Christmas when he reached Constantinople. Here new delays occurred. The Emperor Alexius Comnenus would not consent to allow the crusaders to cross into Asia Minor until the leaders had sworn to give up to him all the lands which they should conquer which had previously belonged to the Roman empire, and to remain his faithful vassals for all time coming. This Godfrey at first indignantly refused to do, but after a long course of hostilities finally yielded to the demands of Alexius. On 1 May 1097 they crossed the Bosporus, and before the end of the year the crusaders encamped before Antioch. The town fell into their hands on 3 June 1098, but the citadel held out much longer. In the following year (15 July 1099) Godfrey took Jerusalem itself, after a five weeks' siege. The infidels were indiscriminately massacred, notwithstanding the endeavors of Godfrey to put a stop to the slaughter. Eight days after the capture of Jerusalem the leaders of the army elected him king of the city and the territory; but Godfrey declined the kingly title, contenting himself with that of duke and guardian of the holy sepulchre. The sultan of Egypt now raised an army of 400,000 men for the purpose of expelling the crusaders, but Godfrey gave him battle in the plain of Ascalon, on which occasion 100,000 men were left dead upon the field. This victory placed him in possession of nearly all the Holy Land. Godfrey now turned his attention to the organization of his newly established government, dying just a year after the capture of Jerusalem. He was buried in the Church of the Holy Sepulchre.

Godfrey of Strasburg. See GOTTFRIED OF STRASBURG.

Godhaven, gŏd'hävn, or **Lieuely,** Greenland, on Disco Island. It is the capital of the Danish Northern Inspectorate. Pop. 220.

Godiva, gō-dī'va, a legendary English heroine. She was the wife of Leofric, Earl of Mercia and Lord of Coventry in the reign of Edward the Confessor. The inhabitants of Coventry having on one occasion offended their master, he punished them by inflicting so heavy a fine that they were unable to pay it. In their distress they appealed to Lady Godiva to intercede for them, saying that if they paid the fine they must starve. Godiva, sympathizing with the people, went to her lord to plead that, for her sake, the tax might be remitted. Leofric, when she persisted in her entreaties, at last said half jocularly and half contemptuously, that he would grant her request if she would ride naked through the town of Coventry. Having first received permission from her lord to fulfil the condition imposed Godiva caused it to be made known on what terms the earl had agreed to relieve the people from the tax, and then proclaimed that on a certain day no one should leave his house before noon, that all windows and other apertures in the houses should be

closed, and that no one should even look out until noon was past. She then mounted naked on her palfrey, rode through the town, and returned; and Leofric, in fulfilment of his promise, and in admiration of his wife's heroism, freed the inhabitants from the burdens he had imposed on them. Only one person, the story says, attempted to look out, and he was immediately struck blind. A mediæval pageant celebrating Godiva's ride was a feature of Coventry fair for several centuries, and an attempt was made to revive the pageant as late as 1883. See Tennyson, 'Godiva.'

God'kin, Edwin Lawrence, American journalist and essayist: b. Moyne, Ireland, 2 Oct. 1831; d. England 20 May 1901. He was graduated from Queen's College and subsequently was correspondent during the Crimean war for the London *Daily News* (1854–6). He came to the United States as correspondent of that journal and after some time spent in travel was admitted to the New York bar in 1858. During the Civil War period he corresponded both for the *Daily News* and the New York *Times*, and in 1865 established 'The Nation,' which was merged with the New York *Evening Post* in 1882. He continued to edit both papers from that date until shortly before his death. He published a 'History of Hungary' (1856); 'The Problems of Modern Democracy'; 'Reflections and Comments'; 'Unforeseen Tendencies of Democracy' (1898). He was an able, forceful writer who often strenuously opposed dominant political tendencies or principles, but whose entire conscientiousness was never disputed. Under his management the *Post* and the 'Nation' acquired a great influence over the more thoughtful members of the community.

Godless Month, the 10th month of the year with the Japanese, so called by them because then the lesser divinities were considered to be absent from their temples for the purpose of paying the annual respects to the celestial Dairi, a word which, in Japanese means "the Great Interior," that is, of the imperial palace, and in a general sense the person of the Mikado, whose title, "King of Heaven" or "Son of Heaven," implies his divine right to such homage.

God'man, John D., American naturalist and medical writer: b. Annapolis, Md., 1794; d. Germantown, Pa., 17 April 1830. In 1813 he entered as a sailor in the flotilla then stationed in Chesapeake Bay, but in 1815 left the service, and commenced the study of medicine. After lecturing for some time at Baltimore in the room of the professor of anatomy in the University of Maryland, and holding a chair of anatomy for a short time at Cincinnati, he settled in Philadelphia as a physician and private teacher of anatomy. His chief work is his 'American Natural History' (1828). He also wrote 'Anatomical Investigations'; 'Account of some Irregularities of Structure and Morbid Anatomy'; 'Rambles of a Naturalist'; etc.

Godmother. See GODFATHER.

Godol'phin, Sidney, 1ST EARL OF, English statesman: b. near Helston, Cornwall, June 1645; d. Saint Albans 15 Sept. 1715. He was an opponent of James, Duke of York, and a supporter of Shaftesbury during the exclusion agitation, but nevertheless continued in office after the accession of James II. On the flight of that monarch, Godolphin voted for a regency, yet was, after the settlement of the crown on William and Mary, made first commissioner of the treasury. During the reign of Anne he was appointed lord high-treasurer of England, and did much to improve the public credit, and check corruption in the administration of the public funds. In 1706 he was made Earl of Godolphin, and four years afterward was obliged to retire from office.

Go'don, Sylvanus William, American naval officer: b. Philadelphia 18 June 1809; d. Blois, France, 10 May 1879. Appointed midshipman in 1819, he was active in the Mexican war, and in the Civil War, in command of the Mohican, with rank of captain, took part in Du Pont's attack on Port Royal (1861). In 1863 he was promoted commodore and in 1864–5 commanded the fourth division of Porter's fleet in the attacks on Fort Fisher. Having commanded the South Atlantic squadron in 1866–7 and the Brooklyn navy-yard in 1868–70, he was retired in 1871 with rank of rear-admiral.

Godowski, gō-dŏv'skē, **Leopold,** Polish-American pianist: b. Vilna, Russian Poland, 13 Feb. 1870. A pupil of the Hochschule of Berlin and afterward of Saint-Saens, he made concert tours in the United States in 1884–5 and 1890–1. In 1895–1900 he was director of the pianoforte department of the Chicago Conservatory, to which post he was again appointed in 1902. His compositions include concert arrangements of well-known works, concert studies, pianoforte works, and songs.

Godoy, José Francesco, hō-sā' frän-thēs'-kō gō-doi', Mexican diplomat: b. Tampico, Mexico, 9 Aug. 1851. He studied law, was admitted to the bar in California, and practised in California and Mexico. He was also active as a journalist, represented Mexico at the San Antonio International Fair (1889–90) and other gatherings of importance, was Mexican *chargé d'affaires* in the Central American republics (1893–6), and became first secretary of the Mexican embassy to the United States in 1896. He wrote various works in English and Spanish.

Godoy, Manuel, DUKE OF ALCUDIA, Spanish noble: better known as the Prince of Peace: b. Badajoz 12 May 1767; d. Paris 4 Oct. 1851. He entered the Guards in 1787, and was admitted to the presence of the queen, whom he at once captivated by his handsome person and pleasing manners. The imbecile king, Charles IV., was as much pleased with him as his spouse, and he was thus established as a favorite. In 1795, as a reward for the part he had taken in concluding peace with France, he was presented with a large landed estate, and made a knight of the Golden Fleece. It was on this occasion also that he was named by the king Prince of Peace. Other honors and largesses continued to shower upon him, till at last the whole power of the Spanish monarchy was concentrated in his hands. As he used it in the promotion of French rather than Spanish interests, he became extremely unpopular, and an outbreak took place in 1808. He in consequence sought an asylum in France, where he employed the influence which he still possessed over the Spanish king to induce him to abdicate in May 1808. Notwithstanding the enormous wealth which he had at

one time accumulated, he lived a long time in Paris in poverty, maintained chiefly by a small pension from Louis Philippe. He was the author of a work published in a French translation made under his supervision (1836–8) under the title of 'Mémoires du Prince de la Paix, Don Manuel Godoy, duc de l'Alcudia.'

God's Truce, a mutual agreement between territorial nobles confirmed and sanctioned by the Church by which war and violence were to be abstained from for a certain period. In the 9th and 10th centuries the empire of Charlemagne had become broken up into small territories, dukedoms, baronies, counties. The right of private war was a settled principle of the times, and dissensions were frequent and bitter. The peasantry and farmers, especially, were sufferers from the ravages of this petty warfare. Even the monasteries, cathedral colleges and seats of learning were not left in peace and everything threatened anarchy and dissolution. It was at this point that the Church stepped in, as the minister of justice and the guardian of moral order. Stern ecclesiastical penalties were fulminated against all who in the reckless feudal warfare should disturb the peace of churches, priests, and tillers of the soil. The Truce of God was instituted and by its provisions no fighting men should go forth to war on certain days. The little border province of Roussilon was the place where this truce was first agreed upon in the year 1027. Fourteen years later the movement had spread over the whole of France, and later it extended to Germany, Italy, Spain, and England. The Truce of God in 1041 provided that peace was to last from Wednesday evening to Monday morning of each week; there was to be no war during Advent and Lent, nor on certain specified holy days; the punishments for contumacy and disobedience were money fines, banishment for a long term of years, and excommunication; protection was specially extended to all women, pilgrims, priests, travelers, merchants, and agriculturists, and also to the farm inplements and live stock of the peasantry. The Peace of God was confirmed by several councils of the Church, more especially by that of Clermont (1095), when Urban II. proclaimed its universal extension throughout Christendom.

Godthaab, gŏt'häb (Danish, "Good Hope"), Greenland, seaport, on the west coast, capital of the Danish Southern Inspectorate. It is the oldest town in Greenland, and was founded in 1721 by Hans Egede, a Norwegian missionary. Pop. 950.

God'win, or **Godwine,** Earl of the West Saxons, an Anglo-Saxon noble; b. about 990; d. 15 April 1053. He assisted Edward the Confessor in ascending the throne, and married to him his daughter Editha. A quarrel afterward arose between him and his son-in-law, occasioned by the partiality of the latter for Norman favorites, and Godwin in consequence headed a rebellion, but was compelled to submit and quit the kingdom. In 1052, however, he returned with an army, forced Edward to enter into negotiations with him, re-established himself triumphantly in his old supremacy, and caused the expulsion from the kingdom of most of the Norman intruders. He was the father of Harold, the last Saxon king.

Godwin, Mary Wollstonecraft, English writer: b. Hoxton, near London, 27 April 1759; d. London 10 Sept. 1797. In 1783 she set up a school with her sisters, with whom she removed to Newington Green, and wrote a pamphlet, entitled 'Thoughts on the Education of Daughters.' Later she produced 'Mary, a Fiction'; 'Original Letters from Real Life,' and the 'Female Reader.' She was one of the first to answer Burke's 'Reflections on the French Revolution,' which answer was followed by her celebrated 'Vindication of the Rights of Women.' She also wrote 'Moral and Historical View of the French Revolution'; 'Letters from Sweden, Norway, and Denmark.' The eccentricity of her theory was equaled by her readiness to put it in practice, which led her first into the indulgence of a romantic but fruitless attachment for the artist Fuseli. She subsequently married Gilbert Imlay, an American, whose desertion caused her to attempt suicide. As this marriage was void, according to English law, she married in 1797 William Godwin, author of 'Political Justice,' etc. See Godwin, 'Memoirs of the Author of a Vindication of the Rights of Women' (1798); Paul, 'Mary Wollstonecraft: Letters to Imlay' (1879).

Godwin, Parke, American journalist: b. Paterson, N. J., 25 Feb. 1816; d. New York 7 Jan. 1904. He graduated at Princeton College in 1834, and having studied law in his native town, was admitted to practice at the bar in Kentucky, but did not pursue the profession. From 1837 to the close of 1853, with the exception of one year, he was the coadjutor of his father-in-law, William Cullen Bryant (q.v.), in the editorial management of the New York *Evening Post.* In 1843, he issued for a time the 'Pathfinder,' a weekly periodical of a literary and political character. While connected with the *Evening Post* he contributed frequently to the 'Democratic Review,' and he also edited 'Putnam's Magazine' for a time. His acquaintance with German literature was exemplified by his translation of Zschokke's tales and of the first part of Goethe's autobiography. Other works of his are: 'A Popular View of the Doctrines of Charles Fourier' (1884); 'Constructive Democracy' (1844); 'Vala, a Mythological Tale' (1851); 'Handbook of Universal Biography' (1851); 'Political Essays' (1856); 'History of France,' 1st vol. (1861); 'Cyclopædia of Biography' (1865); 'Out of the Past' (1870); 'A New Study of Shakespeare's Sonnets' (1900). He has also edited 'The Life and Works of William Cullen Bryant' (1884).

Godwin-Austen, a mountain peak said to be among the highest in the world; in the Mustagh range of the Himalayan system. Its height is 28,250 feet. Distinguished in the records of the great trigonometrical survey only by the sign K2, it was named in 1888 after Lieut.-Col. Godwin-Austen of the Trigonometrical Survey of India.

God'wits, a group of wading-birds allied to the sandpipers but with longer legs and bill, and distinguished from curlews by the straight not decurved bill. They constitute the genus *Limosa,* of which five species are known. All of them are summer residents of the northern

part of the northern hemisphere, but on their migrations reach northern Africa and South America, while one species extends its flight to New Zealand. Our most common American species are the marbled godwit (*L. fedoa*) and the Hudsonian godwit (*L. hæmastica*), both known to gunners as "marlin." They are not nearly so common as are many other shore-birds on the Atlantic coast. In England two other species occur,— the black-tailed godwit (*L. limosa*) and the bar-tailed godwit (*L. lapponica*).

Goepp, Philip Henry, American musician: b. New York 23 June 1864. He was graduated from Harvard in 1884, and was admitted to the bar in Philadelphia in 1888, but turned his attention exclusively to music in 1891, and became active as organist, composer, and instructor. He has published anthems, songs, and part-songs, written some instrumental works yet in MS., and is the author of 'Annals of Music in Philadelphia' (1896); and 'Symphonies and Their Meaning' (1898).

Goes, goiz, **Pero de**, Portuguese colonist: b. Lisbon 1503; d. 1554. He was the leader of De Sousa's Brazilian expedition of 1530, and in 1532 began the successful cultivation of sugar-cane on a plantation not far from the coast of Brazil. Appointed by the king lieutenant to the governor-general, Sousa, he was of great service in the suppression of Indian depredations. It is stated that he carried to Europe (1547) the first specimens of the tobacco-plant seen there.

Goessman, gĕs'man, **Charles Anthony**, American chemist: b. Naumburg, Hesse-Cassel, Germany, 13 June 1827. He was educated at Gottingen, where he was assistant in the chemical laboratory in 1855–7; came to the United States in 1857; in 1857–69 held positions in commercial companies, and in 1866–8 was professor of chemistry in the Rensselaer Polytechnic Institute (Troy, N. Y.). In 1869 he became professor of chemistry in the Massachusetts Agricultural State College, Amherst, Mass., in 1882–94 was director of the State agricultural experiment station there. In 1886–7 he was president of the American Chemical Society. His papers on salt and the chemistry of natural brines, sugar and sugar manufacture, and his experiment station reports, are of particular value.

Goethe, Johann Wolfgang, yō'hän vŏlf'-gäng gē'te, German poet and critic: b. Frankfort on the Main 28 Aug. 1749; d. Weimar 22 March 1832. He attended the University of Leipsic 1765–8 and in 1770 went to Strasburg where he met Herder and familiarized himself with Shakespeare, and in 1771 took his degree. After publishing two dramas anonymously, 'Götz von Berlichingen' in 1773 announced the dawn of a new era in German letters, and in 1774 'The Sorrows of Werther' made him world-famous. In 1775 he accepted the invitation of Duke Carl August and went to Weimar, his home for the rest of his life. His Italian journey, which marked an era in his career, occurred 1786–7. His friendship with Schiller, of far reaching influence in his poet's life, began in 1794, and ended only with Schiller's death in 1805. In 1806 Goethe married Christine Vulpius. For some years after going to Weimar he wrote but little, but his drama of 'Egmont' appeared in 1785, and thenceforward his leisure was devoted to composing, in prose, his great tragedy 'Iphigenie,' recast in verse in 1786; in writing the novel 'Wilhelm Meister'; and in building up his greatest work, 'Faust.' The succession of his works from 1789 forward was 'Tasso,' a drama (1789); 'Metamorphosis of Plants' (1790); 'The Grand Cophta,' a dramatization of the affair of the 'Diamond Necklace'; 'Wilhelm Meister's Apprenticeship' (1796); 'Hermann und Dorothea' (1796–7); 'Elective Affinities' (1808); 'Fiction and Truth' (1811); 'West-Eastern Divan' (1814); 'Wilhelm Meister's Years of Travel' (1821); second part of 'Faust' (1831: the first part had appeared as 'A Fragment' in 1790).

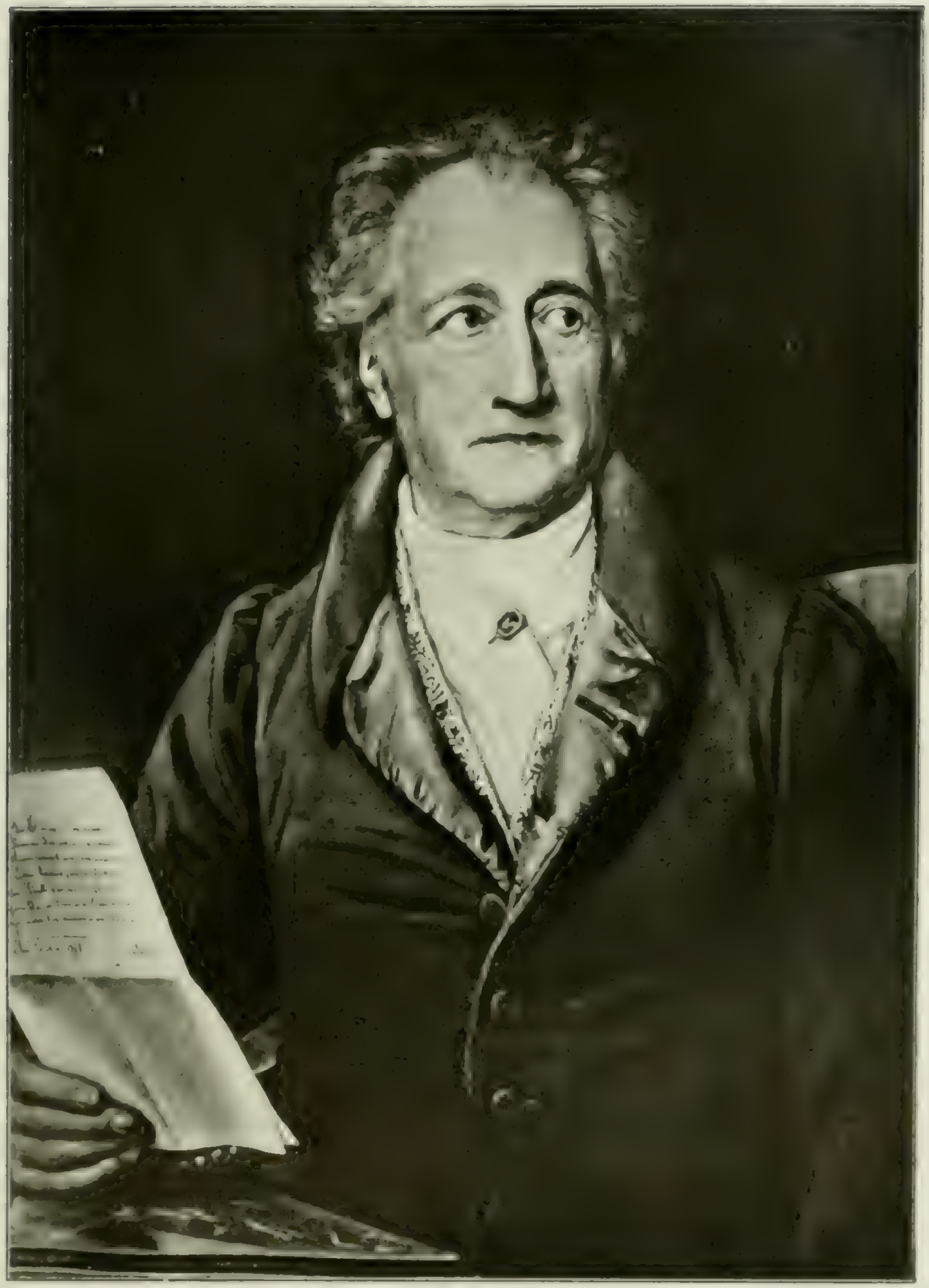
His great life, extending over upward of four-score years, makes him a man of the 18th century and also of the 19th. He belongs not only to German but to European literature. And in the history of European literature his position is that of successor to Voltaire and Rousseau. Voltaire fought to enfranchise the understanding. Rousseau dreamed, brooded, suffered, to emancipate the heart. Here then were Goethe's two great predecessors: one a most vivacious intelligence, the other a brooding sensibility; one aiming at an emancipation of the understanding, but deficient in reverence and in love; the other aiming at an emancipation of the affections, but deficient in sanity of thought. In what relation stood Goethe to these great forces of the 18th century?

In his old age Goethe, speaking of Voltaire, uses the words "a universal source of light." But as a young man he was repelled by him. Into the influence of Rousseau, on the contrary, and into the general movement of feeling to which Rousseau belonged, Goethe in his youth was caught, almost inevitably; and he abandoned himself to it for a time, it might seem without restraint.

Yet Goethe differed from Rousseau as profoundly as he differed from Voltaire. The young creator of "Werther" may seem to have started on his career as a German Rousseau. In reality, "Werther" expressed only a fragment of Goethe's total self. A reserve force of will and an intellect growing daily in clearness and in energy would not permit him to end as Rousseau ended. In 'Götz von Berlichingen' there goes up a cry for freedom; it presents the more masculine side of that spirit of revolt from the bonds of the 18th century, that "return to nature," presented in its more feminine aspects by "Werther." But by degrees it became evident to Goethe that the only true ideal of freedom is a liberation not of the passions, not of the intellect, but of the whole man; that this involves a conciliation of all the powers and faculties within us; and that such a conciliation can be effected only by degrees, and by steadfast toil.

And so we find him willing during ten years at Weimar to undertake work which might appear to be fatal to the development of his genius. To reform army administration, make good roads, work the mines with energetic intelligence, restore the finances to order,— was this fit employment for one born to be a poet? Except a few lyrics and the prose 'Iphigenie,'

these years produced no literary work of importance; yet Goethe himself speaks of them as his "zweite Schriftstellerepoche,"— his second epoch as a writer. They were needful to make him a master in the art of life, needful to put him into possession of all his powers. Men of genius are quick growers; but men of the highest genius, which includes the wisdom of human life, are not speedily ripe. At 26 he was a chief figure in German, even in European, literature; and from 26 to 37 he published, we may say, nothing. But he was well employed in widening the basis of his existence; in organizing his faculties; in conciliating passions, intellect, and will; in applying his mind to the real world; in endeavoring to comprehend it aright; in testing and training his powers by practical activity. A time came when he felt that his will and skill were mature; that he was no longer an apprentice in the art of living, but a master craftsman. Tasks that had grown irksome and were felt to be a distraction from higher duties, he now abandoned. Goethe fled for a time to Italy, there to receive his degree in the high-school of life, and to start upon a course of more advanced studies. Thenceforward until his closing days the record is one of almost uninterrupted labor in his proper fields of literature, art, and science. His task, regarded as a whole, was to do over again the work of the Renaissance. But whereas the Renaissance had been a large national or European movement, advancing toward its ends partly through popular passions and a new enthusiasm, the work which Goethe accomplished was more an affair of intelligence, criticism, conscious self-direction. It was less of a flood sweeping away old dikes and dams, and more of a dawn quietly and gradually drawing back the borders of darkness and widening the skirts of light. A completely developed human being, for the uses of the world,— this was the ideal in which Goethe's thoughts centred, and toward which his most important writings constantly tend. A completely developed State or commonwealth should follow, as an ideal arising out of the needs and demands of a complete individual. Goethe knew that growth comes not by self-observation and self-analysis, but by exercise. Therefore he turned himself and would turn his disciples to action, to the objective world; and in order that this action may be profitable, it must be definite and within a limited sphere. He preaches self-renunciation; the active self-abandonment of devotion to our appropriate work. Such is the teaching of 'Wilhelm Meister': it traces the progress of a youth far from extraordinary, yet having within him the capacity for growth, progress through a thousand errors and illusions, from splendid dreams to modest reality. Life is discovered by Wilhelm to be a difficult piece of scholarship. If we ask,— for this, after all, is the capital question of criticism,— What has Goethe done to make us better? the answer is: He has made each of us aspire and endeavor to be no fragment of manhood, but a man; he has taught us that to squander ourselves in vain desires is the road to spiritual poverty; that to discover our appropriate work, and embody our passion in such work, is the way to true wealth; that such passion and such toil must be not servile, but glad and free; that the use of our intelligence is not chiefly to destroy, but to guide our activity in construction; and that in doing our best work we incorporate ourselves in the best possible way in the life of our fellows. Such lessons may seem obvious; but they had not been taught by Goethe's great predecessors, Voltaire and Rousseau. Sanity for the imagination Goethe found in classical art. The young leader of the Romantic revival in Germany resigned his leadership; he seemed to his contemporaries to have lost the fire and impulse of his youth; his work was found cold and formal. A great change had indeed taken place within him; but his ardor had only grown steadier and stronger, extending now to every part of his complex nature. The change was a transition from what is merely inward and personal to what is outward and general. He did not go into bondage under the authority of the ancients; but he found their methods right, and he endeavored to work as they had worked. For a time the reaction carried him too far. But in the noble drama of 'Iphigenie,' in the epic-idyll of 'Hermann und Dorothea,' and in many of the ballads written during his period of close companionship with Schiller, we have examples of art at once modern in sentiment and classical in method. Goethe's faith in the methods of classical art never passed away, but his narrow exclusiveness yielded. He became, with certain guiding principles which served as a control, a great eclectic, appropriating to his own uses whatever he perceived to be excellent. As in 'Hermann und Dorothea' he unites the influences of Greek art with true German feeling, so in his collection of short lyrics, the 'West-Östlicher Divan' (West-Eastern Divan), he brings together the genius of the Orient and that of the Western world, and sheds over both the spiritual illumination of the wisdom of his elder years. Gradually his creative powers waned, but he was still interested in all — except perhaps politics — that can concern the mind; he was still the greatest of critics, entering with his intelligence into everything and understanding everything, as nearly universal in his sympathies as a human mind can be. The most invulnerable of Goethe's writings are his lyrical poems; against the best of these criticism can allege nothing. They need no interpreter. But the reader who studies them in chronological order will observe that as time went on, the lyric which is a spontaneous jet of feeling is replaced by the lyric in which there is constructive art and considerate evolution. In the poems of the 'West-Östlicher Divan' Goethe returns to the lyric of spontaneity, but their inspiration is rather that of a gracious wisdom, at once serious and playful, than of passion. His period of romance and sentiment is best represented by 'The Sorrows of Werther.' His adult wisdom of life is found most abundantly in 'Wilhelm Meister's Apprenticeship.' The world has long since agreed that if Goethe is to be represented by a single work it shall be by 'Faust.' And even those who perceive that 'Faust' is best understood by being taken along with Goethe's other writings — his early 'Prometheus,' his autobiography, his travels in Italy, his classical dramas, his scientific studies, his work as a critic, his vast correspondence, his conversations in old age — cannot quarrel with the judgment of the world.



JOHANN WOLFGANG GOETHE.

'Faust,' if we include under that name the first and the second parts, is the work of Goethe's whole life. Begun and even far advanced in early manhood, it was taken up again in his midmost years, and completed with a faltering hand in the closing season of his old age. All his works, Goethe said, constituted a great confession. More than any other of his writings, 'Faust' is the confession of his life.

There are two ways in which the reader may deal with 'Faust.' He may choose for his own delight a fragment, detach it and disregard the rest; he may view this fragment, if he pleases, as a whole, as a rounded work of art. Such a reader will refuse to pass beyond the first part of the vast encyclopædic poem. To do this is legitimate. The earliest form in which we possess the drama, that of the transcript made by Fräulein von Göchhausen, is a tragedy which might be named 'The Tragedy of Margaret.' Possibilities of further development lay in the subject, were indeed required by it, and Goethe had probably already conceived certain of them; yet the stadium in the progress of Faust's history included in 'The Tragedy of Margaret' had a unity in itself. But a reader may approach 'Faust' otherwise; he may view it as expressing the complete mind of Goethe on some of the deepest problems of human life. Viewing it thus, he must accept the whole work as Goethe has given it; he must hold in abeyance, at least for a time, his own particular likings and dislikes. While keeping his mind open to all the poetry of 'Faust,' he will soon discover that here is something more than a poem; he finds in it the intellect, the character, the life of Goethe; it is a repository of the deepest thoughts and feelings concerning human existence of a wise seer.

The theme of 'Faust' as originally conceived was the turning of an idealist from his own private thoughts and dreams to the real world; from all that is unnatural,— systems, speculations, barren knowledge,— to nature and the founts of life; from the solitary cell to the company of men; to action, beauty, life, and love. If he can really succeed in achieving this wisely and well, Faust is saved. He is delivered from solitude, the inane of speculation, the vagueness of idealism, and made one with the band of his toiling fellows. But to accompany him there is the spirit of base worldliness, the realist, the cynic, who sees the meaner side of all that is actual, who if possible will seduce Faust into accepting the world apart from that elevating spirit which ennobles actual life, who will try to baffle and degrade Faust by degrading all that he now seeks,— action and beauty and life and love.

It is Goethe himself who is at odds with himself,— the realist Goethe set over against the idealist Goethe; and Mephistopheles is the base realist, the cynic whose endeavor is to mar the union of high poetry and high prose in human life, which union of high poetry with high prose Goethe always looked upon as the true condition of man's activity. Let Mephistopheles, the spirit of negation, try his worst, and at the last discover how an earnest striver's ways are justified by God. Faust may wander, err, fall, and grievously offend,—"as long as man lives, man errs"; but for him who ever strives upward, through all his errors, there is redemption in the end.

See Lives by Schäfer (1851), Lewes (1855), Goedeke (1877), Düntzer (1883), Heinemann (1889), Prem (1900), Witkowsky (1900), Bielschowsky (1902 et seq.); Bernays, 'Der junge Goethe' (1875); Biedermann, 'Goethe Forschungen' (1879–99); Düntzer, 'Zur Goetheforschung' (1891); Zarncke, 'Goethe Schriften' (1897); Weissenfels, 'Der junge Goethe' (1899); Seil, 'Goethe's Stellung zu Religion und Christenthum' (1899); Vogel, 'Goethes Selbstzeugnisse über seine Stellung zur Religion' (1899); Menzel, 'Der Frankfurter Goethe' (1900); Fischer, 'Goethe und Napoleon' (1901); Funk, 'Goethe und Lavater' (1901); Bode, 'Goethes Aesthetik' (1901).

Goethite, gė'tīt, a hydrous sesquioxide of iron, contains when pure 62.9 per cent of iron. It differs from hematite in having a yellow streak and from limonite in containing more water and crystallizing in the orthorhombic system. The lower grade yellow or reddish iron ores of the Lake Superior region, particularly on the Mesabic range in Minnesota, contain considerable goethite and the mineral is thus an iron ore of some importance, though it is not distinguished commercially from limonite. See Iron.

Goetschius, gėt'shĭ-ŭs, **Percy,** American musical scholar: b. Paterson, N. J., 30 Aug. 1853. He was graduated from the Stuttgart Conservatory, became an instructor there, and was appointed to a royal professorship by the king of Würtemberg. In 1890 he received appointment to the professorship of harmony, musical history and advanced pianoforte in the musical department of Syracuse University, and later was professor of composition in the New England Conservatory (Boston, Mass.), from which post he resigned in 1896. He became organist of the First Parish Church (Unitarian) of Brookline, Mass., in 1897. In addition to his compositions, including anthems, sacred songs, and instrumental works, he wrote: 'The Material Used in Musical Composition' (1882); 'The Theory and Practice of Tone Relations' (1892); 'The Homophonic Forms of Musical Composition' (1898).

Goetz, gŏts, **Theodor von,** German painter: b. Lieschen, Siberia, 1826; d. 1892. He began as a genre painter, but in 1848 entered the army and during the Schleswig-Holstein campaigns filled his portfolio with sketches of march and battle. He thenceforward devoted himself to painting military scenes, and became renowned as a battle painter. He took part in the Franco-Prussian war of 1870–1, and painted many striking incidents of the campaign. Noteworthy is his 'Episode in the Battle of Sedan' (1875), one among many remarkable canvases which render him the Horace of Germany.

Goffe, gŏf, **William,** English regicide: b. Sussex, about 1605; d. Hadley, Mass., about 1679. He became a major-general in the parliamentary army, sat in the House of Commons and in Cromwell's 'other House,' and was one of the judges who signed Charles' death warrant. In 1660, with his father-in-law, Gen. Edward Whalley, he fled to America; and they lay in hiding round about New Haven from 1661 to

1664, when they went to Hadley, Massachusetts. There they lived for many years in seclusion; and it is there that, according to the well-known tradition, when the townsmen were called from the meeting-house to repel an Indian attack, and were standing irresolute, Goffe put himself at their head and drove off the foe, and then disappeared as suddenly as he had come. The genuineness of the story, however, has been questioned. His papers have been printed by the Massachusetts Historical Society. See Stiles, 'History of Three of the Judges of King Charles I.' (1794).

Gog and Magog, a king and his nation mentioned in Ezekiel, and the book of Revelations ("the prince of Rosh, Meshech and Tubal from the land of Tubal"). Gog, king of the Magog people, represented the northern hordes, who were to invade western Asia (Ezek. xxxviii. 39). Probably Gog was the Gyges of the Greeks, Gyges being a typical name for kings reigning northwest from the Assyrians. The event predicted was the irruption of the northern nations into Syria.

Gog and Magog are also the names given to two reputed giants of early British history, whose statues are erected in the Guildhall in London. The legend reported by Caxton with reference to these personages declares that they were the last two survivors of the sons of the 33 infamous daughters of the Emperor Diocletian, who, having murdered all their husbands, were sent to sea in a ship, and arriving in Britain and cohabiting there with demons, had a number of giants for their offspring. These giants, it is said, were conquered and brought prisoners to London, where they were kept chained to the gates of a palace on the site of the Guildhall. When they died their place was taken by effigies of them. Effigies called Gog and Magog certainly existed in London at a very early period, and they were sometimes brought out and placed on a conspicuous place to welcome a sovereign entering the city, as was done to Henry V. in 1415; Philip and Mary in 1554; and Queen Elizabeth in 1558. The old effigies were burned in the great fire in 1666. The present figures of Gog and Magog, which are 14 feet high, were erected in 1708.

Gog'gler, or **Goggle-eye,** names given colloquially to several fishes that have prominent eyes, as the rock-bass, the wall-eyed pike, and a tropical crevalle. American gunners call a duck, the surf scoter, "goggle-nose," in reference to spectacles-like spots on its bill.

Gogol, gō'gŏl, **Nik'olai Vassil'jevich,** Russian novelist and dramatist: b. in the government of Poltava 31 March 1809; d. Moscow 21 Feb. 1852. From an early period he manifested a great inclination for dramatic representation, and even endeavored to establish himself in the profession of an actor, but his first appearance was unsuccessful. After filling a situation in a government office, became successively professor of history in the Patriotic Institute, a private tutor, and, lastly, professor of history in the University of St. Petersburg. In none of these did he continue for any time, and presently took up his residence abroad, spending a long period in Italy. His works are extremely popular in Russia for their graphic and humorous delineation of everyday life and manners, and more especially Russian country life. Among them are: 'Evenings at the Farm' (1832); 'Mirgorod,' a collection of tales (1834); 'Dead Souls' (1842), a satirical novel, depicting the public abuses and barbarism of manners prevalent in the provinces; and 'The Reviser,' a satirical comedy of Russian officialdom.

Goitre, goi'tėr, an enlargement of the thyroid gland which may occur sporadically or be endemic. Isolated cases occur the world over. In the United States the disease is comparatively prevalent around Lake Ontario and in parts of Michigan. It is found endemically in the mountainous regions of Switzerland and Italy. The cause is unknown, although certain claims are made that the water is responsible. The symptoms of goitre consist of a more or less uniform enlargement of one or both lobes of the thyroid, causing a puffiness either on one side or both sides of the neck about the region of Adam's apple. When small, no inconvenience is caused thereby, but if the growth becomes extensive, pressure on the important structures of the neck may result in difficulty in breathing, and occasionally sudden death has resulted. Tumors of the thyroid gland such as carcinoma and sarcoma, sometimes simulate goitre. One form of goitre, due to abnormal thyroid function, is known as Graves' disease (q.v.). See EXOPHTHALMIC GOITRE.

Gokcha, gŏk-chä', **Goktscha,** or **Sevanga,** sā-vän'gä, a lake in Erivan, in Transcaucasia, Russia. It is 6,400 feet above the sea and has an area of about 540 square miles. A large number of small streams flow into it, but the outlet, the Sanga, which flows into the Aras, seems to convey only a small portion of the waters to the Caspian Sea.

Golcon'da, Ill., village, county-seat of Pope County; on the Ohio River. It is the trade centre for a large farming country and for a mining district. Its manufactures are chiefly flour and lumber. Pop. 1,200.

Golcon'da, India, an extensive fortress of the Nizam, situated on a granite ridge, seven miles west of Hyderabad, India. In its immediate neighborhood are the ruins of an ancient city, once the metropolis of the powerful kingdom of Golconda, which reached its height at the close of the 16th century and endured till 1687. The place itself is still strong; and about 600 yards distant are the solid mausoleums of its former sovereigns. The fort is held by a small garrison from Hyderabad, and serves as the Nizam's treasury, and also as a state prison. Golconda is proverbially famous for its diamonds; but in truth, they were merely cut and polished here.

Gold (chemical symbol, Au; atomic weight, 187), a metal distinguished from other common metallic elements by its beautiful characteristic yellow color which it preserves untarnished on exposure to the atmosphere under nearly all conditions. Many alloys of copper with zinc, tin, and aluminum have also a more or less golden-yellow color, and are used as substitutes for and imitations of gold, being sold under various fanciful names, such as Dutch metal, Mannheim gold, Abyssinian gold, etc. Some of the bronzes have also a golden color. None of these resist atmospheric action like gold, but some are

fairly permanent under ordinary conditions. Pure gold has a high metallic lustre, but is inferior in this respect to steel, platinum, and silver. The metal possesses a higher specific gravity than any common metal, but is exceeded in this respect by platinum. The specific gravity varies from 19.2 to 19.4, and the metal is thus 1⅔ times heavier than lead and nearly twice as heavy as silver, bulk for bulk. Gold melts at 1045° C., being somewhat less fusible than silver and more fusible than copper. It does not melt in a common fire. At high temperatures the metal is sensibly volatile, and in the intense heat of the oxyhydrogen blowpipe or electric furnace may be vaporized. The vapor is purple.

The pure metal is somewhat harder than lead, but softer than copper, silver, platinum, zinc, or iron. It is consequently too soft, in the pure state, for the purposes to which it is generally applied. For practical application it is alloyed with copper or silver, and both these metals are often present. The former renders the gold redder and the latter paler than its true color. The proportion of gold contained in an alloy is expressed in degrees of fineness, or as "carats" and carat grains (4 grains = 1 carat). The fineness is expressed in parts per thousand, for example 916.6, or decimally, .9166. The carat value of the gold is expressed in parts of 24, pure gold being 24 carats fine. Thus 9-carat gold contains 9 parts of pure gold and 15 of a mixture of copper and silver, etc., commonly known as alloy. Sovereign gold consists of 11 parts gold and 1 copper; guinea gold, of 11 parts gold, ½ part of copper, and ½ part of silver. Standard and guinea gold are thus 22 carats fine (the legal standard for coins in the United Kingdom and colonies), and contain only 2 parts of alloy. The German, American, and Italian standard is 21.6 carat, and is composed of 1 part copper and 9 gold. The following table shows the relative amounts of gold and baser metal in alloys commonly employed:

Carats Fine	Pure Gold	Alloy	Fineness in Thousands
24	24		1000.00
22	22	2	916.66
21.6	21.6	2.4	900.00
18	18	6	750.00
15	15	9	625.00
12	12	12	500.00
9	9	15	37[illegible]
4	4	20	[illegible]

The lowest recognized standard is 9 carat, but much gold of inferior quality is worked up into ornaments and commonly sold as real gold. [illegible] gold is also a common name for this poor material. In the United Kingdom articles of jewelry, plate, etc., are stamped with certain marks known as hall marks, or plate marks, as a guarantee that they have the quality they profess to have. Tampering with hall-marked articles is an indictable offense. Many spurious imitations of hall marks are put upon cheap jewelry, but always differ in some essential feature. Gold alloys of a bad character are frequently colored. This consists in treating the article chemically in such a manner as to dissolve out the base metal constituting the alloy, leaving a covering of purer gold, paler than the original. For this purpose the articles are boiled with 1 part of salt, 1 of alum, 2 of saltpeter dissolved in 4 parts of water, for 20 minutes. Rolled gold is produced by applying thin sheets of gold to a plate of alloy and rolling down the compound sheet.

Pure gold has a tenacity of about 7 tons per square inch, and elongates about 30 per cent before breaking. A wire one tenth of an inch thick will support nearly 200 pounds. Its alloys with copper and silver are stronger. Standard gold has a tenacity of 18 tons (Austen), and extends 34 per cent before breaking. At very low temperatures this is greatly increased (Dewar). Gold is the most malleable of metals, and can be reduced to extremely thin leaves by hammering (see GOLD-BEATING). Such leaves sometimes do not exceed $\frac{1}{250000}$ of an inch in thickness, and transmit green light, though presenting an unbroken metallic surface. This is best seen by mounting on glass. The extreme thinness and high lustre of the metal have led to its use as an illustration of the extreme divisibility of matter. A particle of gold weighing only $\frac{1}{2500000}$ of a grain is readily visible to the naked eye. A grain of gold can be made to cover nearly 80 square inches of surface. The malleability of gold is seriously affected by the presence of minute quantities of arsenic, antimony, bismuth, lead, sulphur, selenium, and tellurium. Of the last 0.2 per cent, and of bismuth 0.5 is sufficient to render the metal crystalline and brittle. Traces of the above elements unfit the metal for gold-beating and coinage. These are removed by passing chlorine gas through the molten metal, or by treating the molten metal with mercuric chloride (corrosive sublimate). By continued hammering the metal is slightly hardened, and must be annealed. Gold surpasses all other metals in respect of ductility. The extreme ductility of the metal is shown by the fact that wires less than $\frac{1}{5000}$ of an inch thick were obtained by Wollaston by encasing a wire of gold in silver and drawing down the compound wire. The silver was dissolved off by treatment with nitric acid. A length of 500 feet of such wire weighs only 1 grain. Gold wire is used for making gold lace. Gold is also extremely flexible and tough. The pure metal breaks with a hackly fracture, but the appearance is greatly affected by impurities.

Chemical Properties.— Gold alloys readily with most metals. It is rapidly attacked by mercury, and dissolves in excess of that metal. If the liquid amalgam be squeezed through wash-leather a yellow pasty mass remains, which may be used in "wash" or "fire" gilding. This process, however, has been largely displaced by electro-gilding, in which the bath consists of the double cyanide of gold and potassium, and is used hot. The metal is unattacked by any of the simple acids, save selenic, but dissolves in any mixture in which chlorine, bromine, or iodine is liberated. The common solvent is aqua regia, a mixture of 1 part nitric acid and 3 or 4 of hydrochloric acid. The chlorine liberated from this mixture converts the gold into the trichloride, an exceedingly soluble body of high tinctorial power, yielding yellow solutions. In the finely-divided state gold is dissolved by chlorine water, bromine water, and iodine solution or tincture, the trichloride, tribromide, and triiodide being produced. It also dissolves in potassium cyanide solutions (in the presence of air) and in cyanogen bromide. These solvents are employed in the extraction of gold from its

ores. Oxides of gold can be prepared with some difficulty. The monoxide is thrown down when caustic potash is boiled with gold chloride solution to which a little acetate of soda has been added. A trioxide (Au_2O_3), a dioxide (Au_2O_2), and a tetroxide (Au_2O_4) are also known. What is known as fulminating gold, $Au_2O_3(NH_3)$, may be prepared by adding ammonia to a solution of gold chloride or by steeping the hydroxide in ammonia. It is a green or brownish powder, which detonates violently when gently heated or when struck. Two classes of gold salts exist. Of the aurous salts, the principal are sodium auro-sulphite, auro-thiosulphate, the cyanide and potassium auro-cyanide. Of the auric salts, the principal are the trichloride and the chlor-aurates. Gold trichloride crystallizes from solution in dark orange-red crystals, $AuCl_3 2H_2O$. It is extremely soluble in water, and volatilizes at 300° in a stream of chlorine gas, but is decomposed on heating to 200° in air with the formation of the monochloride and chlorine, and, at a higher temperature, of gold. It is soluble in ether, naphtha, and essential oils.

The chlor-aurates are combinations of gold chloride with sodium, potassium, and other alkaline chlorides. The best known are $KCl.AuCl_3.2H_2O$, and $NaCl.AuCl_3.2H_2O$, salts commonly sold as gold chloride for photographic purposes. Gold is precipitated from solution by most metals. Iron, copper, and zinc precipitate it readily, generally in a more or less pulverulent form devoid of metallic appearance. Oxalic acid, ferrous sulphate, sulphur dioxide, and sodium sulphite, carbon, grape-sugar, and many organic reducing agents, precipitate the gold from gold chloride. In some cases the metal is so finely divided that it imparts a ruby color to the liquid and does not settle for months. Purple of Cassius is the fine purple pigment produced by treating gold chloride solution with a mixture of tin chlorides, that is, stannous chloride containing a little stannic salt. It is used in glass staining, pottery, and enamel painting, and for coloring artificial gems, imparting a pink, rose, or red color. The addition of tin chloride to the solution obtained by treating an ore with aqua regia and boiling off the excess acid, is a delicate test for the presence of gold. Finely divided gold imparts to pottery and glass a color varying from pink to ruby. Gold resists chemical action to a greater extent than platinum or any other common metal, and in alloys protects base metals from the action of acids to a remarkable extent. Owing to the high specific gravity of gold (19.3) it is possible to roughly determine the richness of the alloy by taking the specific gravity of the article. This is impossible where platinum (specific gravity 21.4) is present in the alloy. The specific gravity of standard gold is 17.157, and of 18-carat gold 16.8.

Assay of Gold.— The touchstone is employed to determine approximately the quality of the gold. It is a hard, black, silicious or flinty slate known also as Lydian stone. Basalt and black Wedgewood ware are also employed. The metal to be examined is rubbed on the stone (any plating or coloring being first scraped off), and the streak compared with that made by needles of known composition differing from each other by one-half carat. The streak is also treated with nitric acid and a test acid, and the result of their action observed. Three or more sets of needles are employed, the chief being a gold-copper series, a gold-silver series, and a gold-silver-copper series. Sometimes five sets are employed, in which the proportions of silver and copper are varied. The series to which the article tested belongs is determined by comparison for color, hardness, and toughness, the latter being inferred from the dryness or greasiness of the streak. The streak is first treated with pure nitric acid (applied with a feather), which is afterward rubbed off. With brass and other spurious copper alloys the streak is completely and instantly dissolved, while poor gold leaves a very faint impression. Nitric acid does not affect any alloy above 15 carats fine. A test acid consisting of 98 parts nitric acid (specific gravity 1.34) and 2 of hydrochloric acid (specific gravity 1.173) is used if the streak has been unaffected by the nitric acid. Gold of 18 carats fine and over is not affected by this mixture in the cold. This method of testing is only used when a rough idea of the richness is all that is necessary for valuation purposes.

Accurate assays of gold alloys are made by wrapping a weighed quantity (either 5 grains or 0.5 gram) in sheet-lead, with sufficient silver to equal three times the weight of pure gold present. Lead to the amount of 34 times the weight of the sample is used for all alloys containing less than 50 per cent of gold, and less for richer alloys. The sample is dropped on to a bone-ash cup (cupel) previously heated to full redness in a muffle furnace. The copper and all base metals in the alloy are oxidized, and the oxides dissolved in the molten litharge formed by the oxidation of the lead added. The fused oxides are absorbed by the porous cupel, thus keeping the metallic surface clear, and at the end of the operation only silver and gold remain behind. After cooling, the button is rolled into a ribbon, annealed, coiled up, and boiled first in nitric acid of 1.16 specific gravity, and afterward in nitric acid of 1.26 specific gravity, to dissolve out the silver, and after washing the coherent cornet of gold is heated to dull redness in an annealing cup and weighed. The addition of silver in assaying is known as inquartation. It is necessary owing to the protective action exerted by gold on other metals.

World Production of Gold.— Gold is very widely distributed, smaller or larger quantities being found in nearly every country. The ancients obtained gold from the Spanish Peninsula, Greece, Asia Minor, and India. The Ophir of the Bible has been variously located. Possibly it was in East Africa. In more modern times Peru, Bolivia, Brazil, Chile, Mexico, and other countries of South and Central America furnished immense supplies of gold after the discovery of America until about 1850. By far the greatest discoveries of gold have been made during the 19th century. The discovery of the Californian placers in 1848, and of the Australian placers in 1851, produced a mad rush to the diggings. In 1858 gold was found in New Zealand, and in 1861 the Otago district became a large producer. Since then immense developments have taken place. Besides California, Montana, Arizona, Colorado, Nevada, Idaho, and others of the United States have furnished, and still furnish large supplies, and Alaska must also be added. British Columbia is an important source, both alluvial and quartz mining being followed. Canada has also entered the lists as

a gold-producer, and the phenomenal discoveries of rich alluvial deposits in the Klondike region in the Yukon basin still furnish excitement. The rich finds in western Australia, in the Calgoorlie and Coolgardie districts, have recently placed that colony in the front rank as a gold-producer, while Victoria, South Australia, and New South Wales have long been large gold-producing countries. In Victoria much energy in the development, more especially of "deep lead" mining, is being put forth. The Witwatersrand district of the Transvaal has sprung into importance since 1886, and Johannesburg is now perhaps the largest gold-mining centre of the world. Russia is also an important producer, the gold being obtained beyond the Ural mountains. India also produces a considerable amount. Of the prospective gold fields the most likely are British Guiana, the hinterland of the Gold Coast, certain parts of China, and possibly East Africa. Gold has been found in several parts of the United Kingdom, principally around Dolgelly, in Merionethshire, in Sutherlandshire, in the Lead Hills, in the Wicklow Mountains, and other places in Ireland. The production of gold in recent years is shown in the tables given below. Such figures, however, are all more or less uncertain:

Country	1896 oz. fine gold	1897 oz. fine gold	1899 oz. fine gold
South Africa...	2,150,106	2,818,403	3,644,880
Australasia ...	2,185,872	[illegible]	3,777,559
Russia	1,041,794	1,121,511	3,164,603
United States..	2,568,132	2,774,935	3,506,679
Other countries	1,874,171	2,075,495	3,081,454
	9,820,075	11,483,712	15,175,184
Value	[illegible]	£48,780,511	£64,309,450

The great increase in the Australian yield is due to the activity in western Australia; in the United States, to Colorado — which now excels California. Canada doubled her output in 1898 — the output being 701,450 ounces. This is due to the Klondike field. The crude bullion from the Transvaal in 1898 amounted to 4,545,014 ounces. In the decade 1831–40 the value of the average annual gold production of the world was £2,831,800; from 1841–50, £7,638,800, the California placers being by this time worked. In the period 1851–5 the average annual value was £[illegible], in 1881–5 only £20,371,777. The phenomenal advance since 1885 is largely due to the development of the Transvaal, but since 1894 the United States, Australia (especially West Australia), and the Klondike region have greatly contributed to the increase: while the cyanide process for treating tailings has led to more perfect recovery of the metal from the ore treated. This phenomenal output of gold — considered along with the fact that much of the ore treated contains only a few pennyweights, and in some cases a few grains to the ton — will give some idea of the enormous amount of capital and energy employed in the search after the precious metal.

Production in the United States. — The following table shows the production of gold in the United States in the calendar year [illegible]:

Alabama	$ 3,900
Alaska	6,9[illegible]
Arizona	4,193,400
California	1[illegible]30,700
Colorado	29,000,000
Georgia	144,900
Idaho	2,273,900
Maryland	200
Michigan	29,000
Missouri	700
Montana	[illegible]
Nevada	[illegible]
New Mexico	[illegible]
North Carolina	65,800
Oregon	1,777,800
South Carolina	[illegible]
South Dakota	6,601,800
Tennessee	200
Texas	1,100
Utah	3,824,300
Virginia	7,400
Washington	620,200
Wyoming	62,000
Total	$80,218,800
British Klondike	17,595,400

The total gold production of the world from the discovery of America by Columbus to the year 1900 is, according to the report of the United States mint, in round numbers, $9,811,000,000. Pure gold of this value would weigh about 16,272 tons, and occupy a space equal to 27,039 cubic feet. Graphically this amount could be represented by a solid circular tower of gold 20 feet in diameter, and 86 feet high. The total yearly world production of gold since 1900 would increase the height of such tower about 3 feet each year.

It has been calculated that the control by England of the African gold mines will result in a largely increased gold supply.

In 1898, the latest complete year before the Boer war, the Witwatersrand, or the "Rand," the Transvaal's principal mining district, produced $60,000,000 in gold. At the rate of increase for the previous few years, maintained through the part of 1800 before the war, the output would have been about $90,000,000 in that year if the conflict had been averted, and more than $100,000,000 in 1900. After mining has been fully resumed, the Rand's annual product, it is estimated by experts on the ground, will soon go up to $100,000,000, and by 1905 or 1906 it will be $125,000,000. It is estimated that that district will yield something like $3,000,000,000 in the next quarter of a century, or before the reef already being worked is exhausted.

There are to-day nearly 1,200 tons of gold in the vaults of the Treasury of the United States — the greatest hoard of the yellow metal ever gathered in the history of the world. Four hundred tons of this gold are piled, like bags of salt, within the four walls of the Sub-Treasury in Wall street, New York. Outside the Treasury hoard there is in circulation through the country a nearly equal amount of gold coin, making more than 2,500 tons of gold in the United States bearing the imprint of the eagle. The total value of this coin is more than $1,260,000,000.

Gold-beaters' Skin, a skin or membrane of great tenacity used in gold-beating (q.v.), and specially prepared from the outer coat of the cæcum of cattle. The intestines of 300 cattle are required to make a single packet or "mould" of gold-beaters' skin, the mould containing about 850 leaves, between which the gold to be hammered out is laid. See Gold-beating.

Gold-beating, the art of hammering gold into leaves of extreme thinness for the purposes of ornamental gilding. For this purpose pure gold is alloyed with small quantities of other

metals according to the color required. Ten colors are recognized: red, pale-red, deep-red, orange, lemon, deep-pale, pale, pale-pale, deep-party, party, besides fine gold. In the deeper colors copper preponderates in the alloy, varying from ½ dwt. to ¾ dwt. per ounce, and no silver. The pale ones contain silver varying from a few grains to 1 dwt. per ounce. The middle ones contain from ¾ to a little over 1 dwt. of alloy, of which ⅔ is silver and ⅓ copper. Ordinary gold-leaf contains about 21 grains of alloy per ounce, and is thus nearly 23-carat fine. The operations are conducted as follows: The metal is melted and cast into ingots, which are rolled out into thin ribands between polished steel rolls. Each ounce of gold is rolled to a length of about 10 feet, the riband being 1½ inches wide and 0.0015 to ,001 inch thick. This is cut up into pieces, each weighing about 6 grains, so that 2 ounces — that is, a "beating" — yields 160 to 170 such pieces. These are packed between intervening sheets of vellum, some 3 inches square, the surfaces of which have been rubbed over with fine plaster of Paris — brime — to prevent the gold from sticking. A number of blank pieces of vellum are placed at the top and bottom of the pile, and the packet is bound with straps of the same material. The cutch thus formed is beaten with a hammer weighing from 17 pounds upward, or by a power hammer, till the gold has been extended to the size of the parchment sheets. The packet is then unbound, the gold squares each divided into four by a steel knife, and the pieces packeted between sheets of gold-beaters' skin (q.v.) about 4½ inches square. A number of blank skins are placed at both top and bottom. The 600 to 700 pieces are all put into the same packet, and comprise what is called the shoder. The shoder is secured by slipping the pile into a parchment band, and again into a similar one at right angles, and is beaten with a round-faced hammer weighing from 9 to 12 pounds, until the gold has extended across the skins. When the gold has filled the shoder each leaf is divided into four pieces with a strip of bamboo sharpened on the long edge. The 2,500 to 2,800 pieces thus obtained are packed in three packets between fine gold-beaters' skin 5 inches square. Each of these packets constitutes a "mold." A large number of blank skins are placed at either side. The packet is secured as before, and each mold is beaten with the "finishing" or gold hammer, weighing from 7 to 10 pounds, till the metal extends to the edges of the skins, and in some places flows over. When the beating is finished the mold is opened. Each leaf is then lifted deftly by long wooden tweezers, placed, with a sudden downward movement, on a leather pad dusted with brime, and from the central part leaves 3⅜ inches square are cut by means of two sharpened bamboo strips fastened parallel to each other. The leaves are placed by the tweezers in books of soft paper rubbed over with red ochre, red bole, and brime to prevent the gold from sticking. If the leaf does not lie flat, a sudden puff of breath, well directed in the centre, lays it flat. Each book contains 25 leaves. Fine gold is more difficult to deal with than that containing a little alloy, owing to its liability to stick when the leaves touch. It, however, beats equally well. The leaf begins to transmit light when $\frac{1}{150000}$ of an inch thick. Ordinary gold-leaf varies from $\frac{1}{200000}$ to $\frac{1}{250000}$ of an inch thick.

Gold Coast Colony, a British crown colony on the coast of West Africa, bounded on the east by Togoland (German), and on the west by the Ivory Coast (French). Its coast line is about 350 miles; its area, inclusive of Adausi, Ashanti, and the Northern Territories, is about 75,000 square miles. Pop. 1,500,000, of whom 500 are Europeans. The native state of Ashanti lies inland, at the back of the central portion of the colony. The territories in the hinterland to the north of Ashanti, were erected into a separate district, the Northern Territories, in 1897 (area 38,000 square miles, pop. 317,964) and placed under the administration of a commissioner. The products are chiefly palm oil, gold, palm kernels, rubber, timber, etc. Chief town, Akkra, pop. 16,267. The government includes a governor, an executive council, and a legislative council of nine, none of whom are elected.

Trouble arose between the king of Kumassi, who had declared himself king of Ashanti in 1894, and the British authorities, and in 1895 an expedition was sent against him, under the command of Sir Francis Scott, which resulted in the submission of the king, who was afterward taken to the coast. The kings of Bekwai and Abodom also made their submission, and the country was placed under British protection, and a resident appointed at Kumassi. The Niger Convention drawn up by the Anglo-French Commission sitting at Paris, and signed 15 June 1898, and the agreement of Germany 1899, settled the boundaries of the hinterland to the west and the north. Bona and Dokta were given up to France, and the French had to concede Wa and other points to the east of the Volta, which had been occupied by them. The railroad from Sekondi to Tarquah was completed 1901, and in 1902 was prolonged 48 miles beyond the latter point. A line is also being laid to the gold mines of Princissu.

Gold-crest, or **Golden-crested Wren.** The British name for one of the Kinglets (q.v.).

Gold Cure, a specific discovered by Dr. Leslie E. Keeley, by the administration of which drunkenness, addiction to such drug habits as taking opium, or cocaine, as well as the tobacco habit are, it is claimed, cured by a renovation of the nerve cells. Dr. Keeley's theory is that all habits of the kind specified above are symptoms of physical disease and disorder, and may be treated like any other affection of the body. Keeley Institutes have been established all over the United States, and there is a Keeley Institute in London. The treatment consists in the administration of bichloride of gold, according to a prescription which has not been made public. According to the testimony of many reformed inebriates of both sexes the results of the Keeley Cure are genuine and lasting. According to the statistics recently issued by the Keeley Institute, the success of the cure extends to all classes. Out of 1,000 consecutive cases treated, 236 were housewives, 150 physicians and surgeons, 50 were without calling, 30 were attorneys, 29 were merchants, 23 were farmers, 20 were dentists; clergymen, authors and actors were also represented.

It takes four to six weeks to accomplish a complete cure, and testimonials are not wanting

from many of the leading men and women in the country as to the efficacy of Dr. Keeley's specific, as they have seen it operating in the case of those who have been submitted to it. "The Keeley League" is an association of 30,000 men who have been cured by the specific and accompanying treatment. The total number which it is claimed have been released from the domination of the drink or drug habit is 300,000.

The discovery was made by Dr. Keeley in 1879, while he was practising physician in Dwight, Ill. In 1880 he opened his first institution at Dwight. The regular medical profession has not accepted with favor the claims of the Keeley Cure.

Gold Hill, Nevada, formerly a distinct village, but now a part of Virginia City. It is about 7,000 feet above the sea. It has rich silver mines, and several quartz mills. Here, on Mount Davidson, is the famous Comstock lode.

Gold Lace, a kind of lace made of gold wire, flattened between two polished steel rollers, into a ribbon which is twisted round a core of silk. The "gold wire" used in the manufacture of gold thread is nearly always composed of pure silver with a thin coating of gold in India. But in European countries it is only the very best qualities of this wire which are made of unalloyed silver. A good quality of English gold thread is made from wire consisting of 1 part of copper added to 25 of silver, which is afterward coated with gold. But alloys of copper and silver in many proportions are used, some wire containing only 1 part of silver to 60 of copper. The silver, or alloy of copper and silver, is made into a rod 1½ inches in diameter, and then annealed and polished to prepare it for its coating of gold. This is laid on in the form of leaves of pure gold, and subjected, for the best qualities of wire, to the fire-gilding process — that is, the gold-coated rod is heated to redness on burning charcoal, which causes the leaf to adhere firmly. Rods so treated are next smeared with wax, and drawn through the holes of a steel drawplate. (See WIRE-DRAWING.) The wire is frequently annealed during the process of drawing, and this requires to be very skilfully done, or the golden tint of the surface is lost. Gold wire for thread is generally drawn down to a size measuring 1,100 to 1,400 yards to the ounce of metal. Finer sizes reach the length of 1,800 to 2,000 yards to the ounce, and to attain this fineness the wire is drawn through perforated gems, such as diamonds or rubies. The fine wire, after being annealed, is flattened between polished steel rollers. Finally the flat wire, or rather ribbon, is wound over yellow or orange colored silk, so as completely to envelop it, by a spinning engine. The gold thread is then finished. Some of the best qualities of the metal covering or "plate" of this thread have 12 pennyweights of gold to the pound of silver or of alloy. Inferior kinds have as little as 2 pennyweights to the pound and still cheaper sorts of thread are covered with flattened copper wire which has received a thin coating of electro-deposited silver, and this afterward receives, on the outside of the thread only, a still thinner electro-deposited coating of gold — two grains of the precious metal covering 3,000 square inches of surface. For this very cheap kind of thread yellow cotton is used instead of silk.

The only difference between gold and silver thread is that the thin coating of gold is wanting on the latter. Gold thread is used in the manufacture of military lace. This, however, is a woven substance and not true lace; but some real lace is made both of gold and silver thread. Both kinds of thread are also used for facings of liveries, and for ecclesiastical robes, altar cloths, and banners. These and other fabrics are either embroidered or woven, but often only in part, with the thread. (See BROCADE; DAMASK; EMBROIDERY.) Much of the "gold thread" used for theatrical dresses and decorations has only a covering of Dutch metal and the "silver thread" in these is spun with a covering of a cheap white alloy, having a mere film of silver on the surface.

Gold Mining. Gold is usually found in nature in the metallic or native state, and may be distinguished from iron and copper pyrites and other yellow metallic minerals by its malleability and softness. Native gold is never pure. Its quality varies from about 800 to 950 fine, or about 20 to 23 carats (see GOLD). Electrum is a native alloy of silver and gold about 500 fine. A native amalgam with mercury also occurs. The metal sometimes occurs crystallized in octahedra and other cubic forms. It is also found in irregular masses which may be nodular, filiform, or arborescent, or it may form thin leaves merely gilding the surfaces of the rock. More commonly it exists in grains irregularly distributed through sand, gravel, or rock. These grains are sometimes so minute as to be invisible to the naked eye, and the presence of gold can only be detected by subjecting the rock to a careful assay, either by grinding with mercury, washing, or fire assay.

The metal occurs in (1) alluvial deposits, or "placers." These are deposits of gravel, sand, clay, or loam, consisting of the debris of weathered rocks, generally transported by running water from hillsides to valleys and plains. They mark and follow the courses of existing rivers or of rivers belonging to former ages. Gold is found in them in all degrees of coarseness, from minute specks or "colors" to masses weighing many ounces. One of these, designated the "Welcome Stranger," found at Dunolly in Victoria, weighed 2,195 ounces troy, and many others of large weight have been found.

These larger masses of gold have usually a more or less rugged and lumpy exterior, and are described as "nuggets." The largest usually occur near the source from which the gold in the alluvium has been derived. This source almost always consists of veins of quartz, or other material, occurring in one of the older rocks. Alluvial deposits vary in character from pipe clay to coarse gravel. The gravel is usually loose, but sometimes in working the deposits intervening layers are met with which are cemented together. These are known as "false bottoms." River sands also frequently contain gold. Alluvial deposits are often very rich, particularly in nuggets. This is largely due to the force of the water carrying forward the light earthy material, while the larger and heavier particles, owing to their greater resistance, accumulate nearer the source. (2) The formation which is known as "deep leads" consists of ancient

river beds that have been covered by more recent deposits of drift, earth, or volcanic rocks, which have become hardened and consolidated. They are composed of sand, gravel, loam, and clay, the so-called "wash-dirt" or "pay dirt" varying from a few inches to several feet in thickness. Formerly these deep leads were the main drainage channels of the country, and in rain storms were heavily flooded, carrying the debris from the hillsides down the creeks and gullies. In Victoria the deep leads are often overlaid with a deposit of basalt known as "bluestone," showing volcanic action to have been instrumental in covering up the deposit. These deposits often extend out beyond the covered portion, and in mining operations trouble is occasioned by water which finds its way in through the exposed portion. Their direction is traced by boring. (3) In the primitive rocks gold occurs generally, though not invariably, in veins of quartz. The terms "lodes," "reefs," "ledges," are also used much in the same sense as veins. The metal is not uniformly dessеminated through the rock, but occurs in most cases in rich streaks and pockets. Careful examination will often reveal its presence, but no general appearance of the quartz can be relied on. Highly mineralized quartz is generally most productive. The minerals usually present are silver, zinc, lead, copper, iron, nickel, bismuth, tellurium, and antimony-bearing minerals, the commonest being iron pyrites, mispickel, zinc blende, galena, copper pyrites, argentite and other silver ores, nagyagite and other tellurides, bismuthine, antimonite, limonite and hematite. Sometimes these — especially iron pyrites — are present in very large quantities. Near the surface this has been completely decomposed and partially converted into oxide of iron, conferring a reddish brown color on the more or less spongy rock. Such decomposed rocks containing much oxide of iron are described as "gossans." In the cavities small particles of free gold can often be observed. In the unaltered portions of the rock the accompanying minerals may be plainly distinguished. The veins may be compact and large, but the mineral streak often occupies only a portion of the lode, though many "leaders" may occur. Much of the lode is sometimes barren. In some quartz deposits the stone is uniformly rich; in others the gold is concentrated at certain points in what are known as pockets. According to a recent report from Cripple Creek, Colo., a mass weighing over a hundredweight with a slight admixture of quartz has been found there. A similar mass of less size was found some years ago in India, and another near Sydney, N. S. W., was 5 feet high, 1 foot wide, and 6 inches thick, full of threads, wires, lumps, and sheets of gold. It realized £15,000. The "banket" ore of South Africa resembles both alluvial deposits and reefs. It consists of a mass of quartz fragments mostly irregular, embedded in a cement of mineralized matter which carries the gold. This, near the surface, is completely "weathered," and an incrustation of oxide of iron remains surrounding the quartz. Strangely enough this deposit resembles a reef rather than an alluvium and extends to great depths. Several "deep" mines are now in operation. No satisfactory explanation can be given of this formation. Ores of other metals frequently contain gold. Iron and copper pyrites, antimonite, galena, and silver ores are often gold bearing. The precious metal is extracted in the smelting of the mineral. Gold occurs also in combination with tellurium and possibly with selenium, as well as in the free state. Most telluric ores are gold bearing, and the presence of this element is often looked on as an indication of gold.

Placer Mining.— When the alluvium is at the surface the exploration of the ground can proceed forthwith, and with pick and shovel the gravel is turned over and the nuggets taken out. The remainder is afterward washed to recover the finer particles of gold, in the pan, the dolly, or the cradle. When the "pay dirt" is covered with soil, etc., the "cover" is first removed to lay it bare, and the washing proceeded with. From the above references the presence of water is a most important item in the satisfactory exploiting of alluvium. The washing of sands and gravels is a simple matter. In washing in the pan —"panning out"— a quantity of the dirt free from the stones is put into a shallow iron or wooden dish some 15 inches in diameter, with a slight depression in the middle. It is then mixed with water, and the dish put with its edge just under water with one side a trifle lower than the other. Any lumps are broken up by hand. By a gentle whirling and jerking motion the sand and other light bodies are washed over the edge of the pan, and the heavy matters containing the gold remain at the bottom and accumulate in the central depression. Pebbles are thrown out, and the "colors" (specks of gold) are then sought after and picked out, or the whole heavy residue saved, dried, and blown, or treated with a little mercury to extract the gold.

The "dolly" or "tossing tub" is intended for washing fine stuff or coarsely crushed material passing through a sieve having 12 meshes to the linear inch. It consists of a circular tub in which the dirt is mixed with sufficient water, and is stirred around with a shovel or other implement three or four minutes. A little of the water is then removed, and the tub struck on its sides for some few minutes with a hammer to quicken the subsidence of the heavy matters. The water is then poured off with the lightest matters, and the upper portions of the remaining mud scraped off and thrown aside. Some fresh dirt is added and the operation repeated. By this means a gradual accumulation of gold takes places at the bottom of the tub — or kieve, as it is called — and is removed from time to time. Some tossing tubs are provided with rotary stirrers.

The "cradle" consists of a short box or trough six or seven feet long, mounted on a kind of rockers, and slightly inclined to allow the mud to run off. A box with a bottom of iron plate perforated with half-inch holes is placed over the higher end of the trough. Underneath this an inclined plate directs the stuff to the top of the trough, across the bottom of which strips of wood called riffles, about half an inch thick, are fixed transversely to arrest the heavy particles of gold. The "pay dirt" is thrown into the box at the top, and water is led into or poured on it. The finer portion is thus carried through the holes into the trough. Lumps are broken up and the cradle rocked from side to side with a jerking motion. The light matters are carried away by the water from the lower end of the trough, and the particles

of gold and other heavy matters lodge behind the bars and are afterward collected.

Sluicing.— This is the method adopted where practicable for treating alluvial deposits. The "sluices" consist of troughs called "flumes," in sections about 12 feet long, mounted on trestles to give a sufficient inclination — from ¾ to 1½ inch to the foot. The lower ends of the troughs fit into the upper ends of the succeeding sections. The bottom of the sluice box is crossed transversely by bars of wood or iron. In long sluices these are about two inches thick and are supported by longitudinal bars, dividing the bottom of the sluice into rectangular spaces. The gravel is placed at the top and washed down by a stream of water, while the lumps in the hand sluices are broken up by raking them.

The smallest of the sluices, known as the "long tom," and worked by two or three men, consists of two such sections. Into the upper one the gravel is thrown, and the lower end is closed by an iron grid set at an angle, to keep back the pebbles and large stones, while the sand, etc., passes through to the lower trough. In this it deposits its gold and heavy matters behind the riffle bars which in these shorter sluices are not so thick. The longer sluices, for dealing with larger quantities of material at a time, are made 250 feet long, or longer in many cases, and if there are many stones in the stuff to be treated, the sluice is divided into two sections, placed at different levels. The lower end of the upper section is not blocked, but near it the bottom consists of an iron grating — the "grizzly." The stones are washed forward over the grating, and fall or are raked out at the end. Under the grating is the second section of the sluice, often arranged at right angles, or to run in an opposite direction and with a smaller inclination. On this the sand and fine particles carried by the water fall, so that the smaller particles of gold may be recovered. In sluicing, mercury is often fed in at the top of the sluice in order to amalgamate the gold, and the amalgam then lodges behind the riffles. In other cases the fine sand, after passing through the first section of the sluice, falls on inclined tables covered with blankets, rough cloth, or hides with the hairy side up, over which it flows in a thin stream. These "blanket strakes" serve to arrest and recover the fine gold. Amalgamated copper plates are employed for the same purpose in some cases, over which the fine sand flows before running to waste.

In dealing with the hard "cements" and "deep leads," the material is generally first treated in a "puddling" machine. In this the pay dirt is disintegrated by edge runners, or revolving rakes or harrows, or some other form of crushing or stirring apparatus, while a current of water carries the debris from the machine into the flumes and over the strakes. Much of the coarse gold remains in the puddling machine. Where the configuration of the ground admits, there is no difficulty in getting the necessary fall, but where the surface is level this has to be obtained artificially, by erecting very high poppet-heads over the shafts from which the pay dirt is drawn. In some cases these are over 100 feet in height, the puddlers being placed on a platform at a suitable elevation, from which the flumes slant downward, being caried on trestles.

Hydraulic Mining.— In places where the ground is suitable, these deep leads and other alluvial deposits are worked by washing down the gravel by means of a powerful jet of water, a head of 200 to 250 feet being sometimes employed. The jet is delivered from a movable pivoted nozzle — the "monitor" or "giant"— against the bank of auriferous material, and the detached debris washed into sluices where the gold is deposited. These sluices are larger than those already mentioned, being sometimes 5 to 6 feet in width, 2 to 3 feet deep, and are often paved with stone and provided with iron riffle bars. Some of them are upward of a mile long. Mercury is always fed in at the top, and the amalgam recovered by raising the riffle bars after turning off the water and cleaning out the gravel. An immense water supply is required for this purpose, and the water is often brought for miles in "flumes" which cross gulches and valleys supported on trestles, and are carried in tunnels through hills. This is the cheapest mode of working. From two to four grains of gold per ton, and in some few cases less, is sufficient to pay expenses. If the material is exceptionally hard, blasting is resorted to in order to break it down, when the action of the jet is sufficient to disintegrate it. A "miner's inch" of water is the quantity that will flow through a hole an inch square in an inch board, under a head usually of 7 inches, but more or less according to the locality, the time of flow being specified. A 24-hour inch at 7 inches pressure is nearly 14,000 gallons. In other cases an inch reaches 17,000 gallons. The river gravels of Scotland, Ireland, and Wales, and many parts of Europe, have yielded gold, but the richest of such deposits are those of California, Klondike, and Australia. Magnetic iron sand, tin stone, ilmenite, sulphides, garnets, and diamonds are often associated with alluvial gold.

Quartz Mining.— In dealing with the material from veins or reefs of quartz and other hard substances containing free gold, the stuff is reduced to fine powder and then passed, suspended in water, over copper plates amalgamated with mercury, to which the gold adheres. The "tailings" are then treated either by "concentration" and the concentrates chlorinated, or the whole of the tailings is treated by the cyanide process. The ore to be crushed is first passed through a "stone breaker" or "ore crusher." In the Blake type the moving jaw permits the introduction of the larger lumps at the top, but only allows the crushed material to pass out at the bottom in pieces a little larger than walnuts. In the Gates type a gyrating cone revolves inside a fixed vertical cone. Both have ribbed surfaces, and they are of different angles, so that the large material introduced at the top is broken down before it can pass out at the bottom. The broken ore passes to the ore bins, thence to the feeders and on to the stamps, or some form of grinding mill. The lower part of the battery consists of a cast-iron box — "mortar box"— fitted on one or both sides with a fine screen of wire-cloth or perforated sheet metal. At the bottom of this box is a row of iron blocks called "dies," on which the stamps fall. The stamps are heavy cylindrical cast-iron blocks — heads — to which are attached loose steel facing pieces —"shoes"— fixed to the lower ends of the vertical iron rods — stems — moving up and down between guides carried by the framing. The stamps are raised by cams keyed on the revolving shaft. These engage with collars

— tappets — fixed on the stems. As the shaft revolves, the cam raises the stamp twice in each revolution and allows it to fall when the cam passes. The stamps are thus kept pounding away at the ore in the mortar box. The heads and their attachments weigh up to nearly half a ton, and make from 70 to 90 blows per minute. Five heads usually constitute a battery. Some mines have 200 stamps at work. Each head should crush about one and a half to two tons of ore per day. The motive power may be steam-engines or turbines. Some mills are driven electrically. In wet crushing mills a stream of water is admitted to the mortar box, and carries the crushed material through the screens. Mercury is fed into the mortar boxes in small quantities, and much of the gold is retained there on amalgamated copper plates. Slightly inclined amalgamated copper plates arranged in steps are placed in front of the battery, and over these the crushed ore pulp passes slowly as it leaves the mortar box, the gold being retained by the amalgamated surfaces. The plate nearest the battery is generally heavily silver plated. The "tailings" which may still contain some gold are treated as described below. The stamp battery is often replaced by roller crushing machines and grinding mills of various types, the objects of which are the same; and with certain ores these are even more effective. The best known of these are Krom rolls and the Huntingdon mill. Steam stamps are also employed, making up to 200 blows per minute.

Treatment of Amalgam.— The amalgam, both that which is retained on plates placed in the battery and that which accumulates on the plates outside, is collected from time to time. The plate just outside on which the splash from the battery falls, is made small so as to be readily removable for cleaning up. The other plates are not so often disturbed. The amalgam is ground with water in a small iron pan with a revolving muller —"clean-up pan"— to cleanse the amalgam from sand, etc. Afterward it is pressed in wash-leather, canvas, or other material to expel the excess of mercury, which is returned to the battery as required. The residue is "retorted," that is, it is heated in retorts to expel the mercury, which is condensed and recovered. The gold obtained is subsequently melted in crucibles and afterward refined. "Free-milling" ores yield nearly the whole of their gold by this treatment. Ores containing sulphides, arsenides, antimony, tellurium, etc., do not, and are described as "refractory ores." Free-milling ores are generally "weathered"; the minerals having been decomposed by the action of the atmosphere and water.

Treatment of Tailings.— Tailings always contain gold, either as "float" gold, "rusty" gold, or bound up in pyrites or other mineral occurring in the rock. Pulp (that is, the crushed rock) containing float gold is led through amalgamating pans, where it is ground with mercury before running to waste. In dealing with pyritical ores, when chlorination or grinding with mercury is resorted to, the pulp is passed to concentrating appliances, blankets, strakes and "vanners" being employed. Vanners are by far the most effective and generally employed. Each consists of a slightly sloping table, formed of an endless traveling belt of india-rubber which is stretched over rollers at the ends of a frame, and so mounted as to be capable of violent agitation while moving slowly in an upward direction. The vibrations number 200 a minute. The pulp is led on at the higher end, and the flow of the water carries the light matters down the slope, the separation being greatly assisted by the shaking movement. The residue is also sprayed with water, and the heavy matters only are carried forward by the belt over the higher end and pass into a box below, being then known as "concentrates." These may be ground for a prolonged period with mercury (old fashioned), or treated by chlorination. For cyanide treatment, concentration is unnecessary.

Chlorination Processes.— The concentrates are first calcined to remove the sulphur and arsenic, and to render the material more porous. The residue is treated in vats provided with false bottoms and with filter beds, or other suitable receptacles, having tightly fitting covers. The calcined ore, as free as possible from "slimes"— very fine material which becomes impervious when wet — is dampened with water and sifted into the vats, in order that it may lie lightly. The cover is put on and luted, but a plug in the top taken out. Chlorine gas is admitted slowly under the false bottom of the vat through a pipe for that purpose, and gradually lifts out the air. The plug is then inserted, and the chlorine allowed to act for some 30 to 40 hours, fresh supplies of the gas being added if found necessary. The vat is then ventilated. the cover removed, and the ore treated with water several times to dissolve the chloride of gold that has been formed. The solution drains through the filter bed, and passes out into the settling tank, where any sand, etc., is deposited. From the settlers it passes to the precipitating tanks, where a solution of sulphate of iron — ferrous sulphate — or other precipitant is added, and the whole thoroughly paddled or mixed by mechanical stirrers. The gold is thus precipitated as a brownish purple powder, which is allowed to settle, and the liquor is then siphoned off. Several batches of solution are thus treated, and the gold obtained is collected, washed with acids, dried, and melted in crucibles. Many modifications of the original process with special forms of plant have been introduced. In the Newberry-Vautin process air is pumped into the chlorinating vessel to increase the pressure; in the Pollok process hydraulic pressure and rotation are employed; and the Mears works under pressure of chlorine. In several of these modifications the chlorine is generated in the chlorinating vessel by means of bleaching powder, and either sulphuric acid or acid sulphate of soda. Various precipitants have also been employed. See Gold.

Pyritic Smelting.— This term is applied to a method of smelting pyritic gold ores in cupolas, with or without the addition of coke. If the ore contains above 40 per cent of sulphur no coke is necessary. On charging the ore into the cupola some of the sulphur is driven off by the heat, and part of the remainder when it reaches the twyers burns and furnishes sufficient heat to melt the regulus — a sulphide — and slag off the ferrous oxide resulting, and the quartz. A plentiful supply of air is required. The gold remains in the regulus, which also contains any copper present.

Gold Refining and Parting.— The crude bullion is dealt with according to its purity. Very

base bullion is cupelled with lead, only the silver and gold remaining on the cupel. When less impure it is melted in crucibles and nitre and borax added to oxidize and flux the copper and other metals it contains. After this treatment the bullion still contains silver as well as small quantities of other metals, to separate which the gold is "parted." This is effected by boiling the alloy in acids to dissolve out the silver, but unless a sufficient quantity of silver is present the acid will not completely dissolve it. The gold is first alloyed with the necessary quantity of silver. For nitric acid parting the alloy contains two and a half or three times as much silver as gold. When sulphuric acid is employed it contains four times as much or more. The alloy is granulated by pouring the molten metal into water, and the granulated metal is then boiled with nitric acid in glass or platinum vessels, whereby the silver is converted into silver nitrate and dissolved, the gold remaining unattacked. After drawing off the solution the residue is washed, dried, and melted down. The silver in the solution is afterward recovered by precipitating it with hydrochloric acid as chloride, which is subsequently reduced to metal. At the same time the nitric acid is recovered. Sulphuric acid is often used in place of nitric, particularly in dealing with silver containing a little gold. The granulated metal is first boiled with sulphuric acid, in iron pans, suitably provided with covers to carry off the vapors for the recovery of the acid. This converts the silver into soluble sulphate of silver. After a second treatment the residue is washed, dried, and melted down. The silver is recovered from the sulphate by treatment with ferrous sulphate or other reducing agent, or by passing the solution over metallic copper, by which it is precipitated. The precipitated silver is afterward washed and melted down. When little silver is present it may be removed by melting the gold in a crucible and bubbling chlorine gas through the molten metal by means of a clay tube passing through a hole in the cover. The silver is converted into chloride, which melts and rises to the top of the metal. The gold is not chloridized, the temperature being sufficient to completely decompose its chloride. The scum contains some gold, and this is afterward recovered. Besides removing the silver, any traces of lead, antimony, bismuth, tellurium, or other base metals which would render the metal brittle are converted into chlorides and volatilized so that the metal is left tough and malleable. The process is often employed to toughen brittle gold. The employment of bichloride of mercury by gold-beaters to toughen the gold used for that purpose produces a similar effect, the chloride of mercury giving up half its chlorine for the purpose, and being volatilized as calomel. Platinum is separated from gold by alloying with so much silver as to reduce the platinum below 9 per cent. The alloy is then parted by nitric acid, when the platinum dissolves out with the silver. Osm-iridium, a hard alloy, which often occurs with alluvial gold, is removed from the metal before parting by allowing it to subside to the bottom of the pot after addition of silver. This it does owing to its being heavier than gold.

The Cyanide Process.— As defined in the letters patent, this process consists in separating precious metals from ore containing base metal by subjecting the powdered ore to the action of a cyanide solution containing cyanogen to one thousand parts of water. By treating the ore with this dilute cyanide solution, the gold or silver is obtained in the solution, while any base metals in the ore are left undissolved. From this latter solution the gold is precipitated by its disposition on filiform zinc. Chemically, the process is based on this reaction in which a double cyanide of gold and potassium is formed: $2An + 4KCy + O + H_2O = 2K\,An\,Cy_2 + 2KHO$, or according to Feldtmann in his 'Notes on Gold Extraction': $2An + 8HCy + 3O = 2An\,H\,Cy_4 + H_2O$. Two parts of gold plus four parts of cyanide of potassium, plus oxygen from the air, plus one part of water equals two parts of double cyanide of gold and two parts of potassium hydrate. The cyanide process is especially valuable in treating tailings heretofore left on the dumps, not being collectible on the amalgamated plates as is the coarser gold. For cyanide treatment, the free milling ore-tailings should be taken directly from the battery to the cyanide works as any decomposition products vitiates the action of the cyanide.

Stages in the Cyanide Treatment.— The first process consists in passing a dilute alkaline and cyanide wash through the powdered ore, saturating the latter. This first alkaline wash may be 3 parts cyanide of potassium (KCy) to 2,000 parts water and should contain 4 ounces of caustic soda per ton of the wash; after this, the saturated ore should leach for say three hours. The next process consists in passing a much stronger cyanide solution over the washed ore. This second solution should contain from one third to one half of 1 per cent cyanide of potassium (KCy), and 100 per cent water, according to the richness and nature of the tailings to be treated, and the diluted cyanide solution should not be less than one third the weight of the tailings in the vats. For this solution and its contact with the ore at least five hours should be allowed, after which the ore should remain nearly double this time in leaching and three or four for drying. It may now be assumed that much of the gold is in solution. The next process is to subject these tailings to another wash, the object being to wash out the dissolved gold. For this purpose, after the previous strong solution has been drained off, a wash of three fourths to four fifths of the weight of the ore and composed of 3 parts cyanide of potassium (KCy) to 2,000 parts water is used. The ore treated by this weak solution should remain for draining off six or eight hours; finally, a water wash should be applied, the quantity of water used being 7 per cent or more of the weight of this ore; this should be leached off for several hours.

The Precipitation.— The cyanide solutions containing gold, as they flow from the leaching vats, are passed through one or more precipitating boxes containing zinc shavings upon which the gold is precipitated. The quantity of gold cyanide solution flowing through each box containing the zinc shavings must be carefully regulated; which may be ascertained by assaying the solution at intervals. The zinc shavings having reconverted the gold into metallic forms, the next process is the collection of the metal. Care should be taken that no iron or metal other than zinc be exposed to the solutions in the boxes. The tray holding the zinc shavings is

lifted out from the last compartment and moved up and down so that the fine particles of slime and zinc should fall through the sieve and settle in the bottom of the box.

The zinc shavings are next taken out of the tray and rubbed in the water to remove all the gold possible adhering to them. The tray is turned over and brushed down so as to remove any gold adhering to it. After this the solution of water in the zinc boxes is pumped into settling tanks, where it is allowed to stand for two weeks; thus giving the extremely fine particles of gold held in the suspension time to settle. Great care should be taken in pumping not to disturb the gold-zinc slimes at the bottom of the box. The gold-zinc slimes are now shoveled into enameled iron buckets and discharged through a 900-inch sieve, and washed and rubbed into the gold clean-up tank. The water having settled in the latter tank is siphoned off, and the precipitate (gold-shines) is drained off through plug holes and deposited upon a calico or linen filter, or into a filter press. When sufficiently dry, the gold-shines are on an iron plate or in iron pots and are ready for roasting and smelting, the object being to oxidize the greatest portion of the zinc which in the form of small chips and shavings, has fallen through the zinc box trays. Having placed the dried precipitate in a plumbago crucible and covered the same with usual fluxes — bi-carbonate of soda, borax, and sand in the proportion of 50 per cent bicarb., 25 per cent borax and 16 per cent sand to 100 per cent by weight of precipitate — the entire mass is melted, poured into molds, and after settling and cooling may be turned out, and freed from the slag by hammering off the latter. Thus the pure gold bullion is obtained. In the treatment of ore-tailings by the cyanide process, the amount of cyanide necessary varies from three fourths of a pound to one and one fourth pounds per ton of tailings, and the cost of this amount is insignificant.

Estimates on the cost of cyanide plants can be only approximately stated. The following figures may, however, be considered within limits:

To treat 3,000 tons of ore per month	$25,000
To treat 5,000 tons of ore per month	37,500
To treat 7,000 tons of ore per month	50,000
To treat 16,000 tons of ore per month	90,000

Gold Mining, Dry Placer Method.— The latest invention of Thomas A. Edison has perfected a device for separating the gold from the placer gravel without the use of water. It has been impossible to work these fields because the water needed for the proper operation of the hydraulic system was not at hand.

Mr. Edison employs an air blast to separate the gold from the gravel and other impurities. Like most of his inventions this one is simple.

The old placer system, with the hydraulic stream, got out 75 per cent of the gold, but with Mr. Edison's system of dry washing, it is said, 98 per cent of the gold is saved. When water is obtainable the new system cannot compete with the hydraulic, because the stream washes out gold at the cost of 3 cents a ton while the new plan costs 8 cents.

After the gravel has been excavated by steam shovels it is conveyed to the mill, where it passes through, or over, a series of screens, thereby being separated into particles of uniform size. Each separator is so constructed as to handle gravel of a certain size, and the gravel is distributed automatically to a machine and thence passes to a hopper, situated on top of the separator. Here a roller regulates the feed of the gravel through a narrow slit in the top of the machine, and the gravel falls to the bottom.

Back of this slot and under it there is a rotary blower, which directs a powerful blast against the falling gravel, which falls down almost as a thin screen. The heaviest metal falls directly to the bottom of the separator, but the blast throws the lighter gravel, black sand and iron into a separate compartment, leaving the gold alone and so nearly undefiled that any impurities may be removed by simple processes.

Bibliography and References.— Eissler, 'The Cyanide Process for the Extraction of Gold'; Travis, 'Reports on the Cyanide Process'; Fade, 'The Cyanide Process'; Edgecomb, 'Practical Cyanidation of Tailings and Ores'; Hardesty, 'The Largest Cyanide Gold Reduction Works in the World'; Wilson, 'Cyanide Processes'; Koch, 'Modern Methods of Gold Extraction'; Rose, 'The Extraction of Gold and the Cyanide Process'; Bosquis, 'Practical Notes on the Cyanide Process'; James, 'Cyanide Practice'; 'The Cyanide Process'; 'Engineering and Mining Journal,' October 1902.

Gold of Pleasure, an annual cruciferous plant (*Camelina sativa*), with abundant yellow flowers, called "cameline" by the French and "dotter" in Germany. It is a weed in lint-fields, but is also cultivated in parts of Europe for the sake of the oil in its seeds. Its seeds and oil-cake are, however, inferior to those of flax, rape or colza. The stems are used for thatch, and made into brooms; and their fibres are sometimes woven into very coarse cloth and packing-paper. The seeds are used for emollient poultices. *C. dentata* is similar, but is not cultivated.

Gold Reserve (United States Treasury). All banking institutions must retain, to pay to depositors or note-holders who may wish to recall their money or claim the fulfilment of the promises on the notes, a stock of coin of a kind satisfactory to the claimants. The amount of this "reserve" needed in quiet times is ascertainable by experience, and is but a small part of the total deposits or issues, as only a small and calculable percentage of customers will wish their money at one time; in times of panic no estimate can be made. The United States formerly directed the Treasury Department to hold a reserve of $100,000,000 in gold, to protect its credit; but the silver panic of 1894 showed that no such arbitrary figure is of any value. When no fear of government solvency was entertained, scarcely any was needed; when the enormous silver purchases had come to threaten a breakdown of national credit by its coming on the market, the sudden rush for gold brought the reserve within three days of extinction, and only the sales of bonds and the knowledge that the policy would be pursued prevented suspension of specie payments. The abandonment of the silver policy has made another "run" less likely; but the government prefers to retain a larger reserve than the former limit. The nominal reserve (see article below) is now $150,000,000; and the recent good business years and excess of exports had brought

the actual cash on hand 1 Nov. 1902 up to $350,421,878.30.

Gold Standard and Gold Production. The metal gold is the only substance of which the earth is composed that is freely accepted in return for all services and in exchange for all other kinds of property by every race in the world. In other words, it is the world's standard of value; the one commodity the market for which cannot be glutted; the one substance that is everywhere accepted not only without compulsion and without limit as to quantity, but that is also the particular object of universal desire. As a mineral it has a history that is probably almost as old as the human race that has fought for its possession with so much avidity. No less than 1,400 years before the dawn of the Christian era, the Greeks were using it as an object of ornamentation, and yet even they were not the originators of the practice. They had borrowed the custom of wearing gold to make the person more attractive from the Egyptians, a people that had decked its women in gold more than 1,000 years before the Greeks had dreamed of utilizing it in this manner. It was, of course, the use of gold as an ornament that first suggested its subsequent use as money, and that finally made it the standard upon which the coinage of the world is based.

Among the many things for which the 19th century will always be memorable not the least important will be the fact that it was during this period that the single gold standard was adopted by practically all the civilized nations of the earth. Beginning with a monetary system that, in a broad sense, may be described as the double standard of silver and gold, the nations of the ancient world maintained this method until sometime in the Middle Age. From about the beginning of the seventh century, however, and until sometime in the 13th century, the single silver standard of coinage prevailed, and, when the double standard was then reintroduced, it remained in vogue until the 19th century, when the progressive financiers began to appreciate the need of a better system.

England was the nation that led the way in the work of exchanging the double standard of silver and gold for the single gold standard, but, while this was done in 1816, other countries were slow to follow in her footsteps. It was not until 1854, therefore, that the double standard was superseded by the single standard in Portugal, but Germany followed in 1871; the United States, in 1873; the Scandinavian States, in 1874; Holland, in 1875; France and the Latin Union, in 1876; Austria-Hungary, in 1892; British India, in 1893; Japan, in 1898, and Russia, in 1899. The gold standard also prevails in Roumania, Servia, Turkey, and Egypt, but, while all the South and Central American countries, with the exception of Bolivia, Colombia, Guatemala, Honduras, Nicaragua, Salvador, and Paraguay have adopted it, most of them are almost hopelessly entangled in a mass of irredeemable paper. It may thus be seen that, among all the nations of importance, China and Mexico alone failed to adopt the single gold standard during the 19th century, while the latter is now (1905) taking the necessary steps to remedy her financial ills by the adoption of such a standard.

It was not alone for this reason that the 19th century was closely identified with the history of gold, however, for it is this period that will always be noted for having been the occasion of two great events in the world's record; the greatest discovery of gold and the greatest production of gold. According to the statistics prepared by the director of the mint, the world's production of gold during the first half of the 19th century was $787,463,000, while, for the second half, it was $6,909,040,000. At the beginning of the century the most important gold-producing countries were Mexico, Colombia, Peru, Brazil, and Buenos Ayres, in the western hemisphere, and Russia and Hungary in the eastern hemisphere. With the exception of small quantities that were obtained in Africa and from the East Indies there was practically no other places where the metal could be found. During the period from 1801 to 1810, the average annual yield of these countries was not in excess of $12,000,000, and fully two-thirds of this amount came from the American mines. Owing to the revolutionary disturbances that broke out in Mexico and throughout South and Central America during the period between 1810 and 1824, the output of gold, as well as that of silver, was greatly reduced. At this time the world's production of gold declined until it reached the comparatively low average of about $7,600,000 per annum, an amount which, in the opinion of William Jacob, one of the best authorities of that period, was insufficient to supply the quantity used in the arts and to make good the loss by accidents, such as by abrasion, shipwreck, etc. As the restoration of peace was quite generally effected about this time, however, disaster was avoided ,for the increase in the production of gold, which began at once, steadily continued. Even the average output of Russia commenced to show some remarkable gains, her production between 1837 and 1848, averaging more than $12,500,000 per annum, which was in excess of the production of the entire world at the beginning of the century. The following table gives the details of the world's production during the first half of the century as computed by the director of the mint:

PERIOD.	Annual average	Total for period
1801-1810	$11,815,000	$118,152,000
1811-1820	7,606,000	76,063,000
1821-1830	9,448,000	94,479,000
1831-1840	13,484,000	134,841,000
1841-1850	36,393,000	363,928,000
Half-century	$15,749,200	$787,463,000

The era of gold discovery dates from 1848, when James Wilson Marshall, on 19 January, discovered a small lump of gold in the tail-race of Sutter's saw-mill, in El Dorado County, Cal. Naturally such a discovery led to a search, not only of the bed of the stream but in the adjoining ground, and, in both places, rich deposits of the precious metal were found. The story of the rush that followed this find of new gold fields is a familiar tale to readers of American history. The news spread like wildfire through California, down the Pacific coast to South America, and finally east to the Atlantic States, and so to Europe. In response to these tid-

ings gold hunters flocked from every inhabitable portion of the globe, with the result that the gold production of California alone amounted to $36,000,000, or a sum equal to that which the annual average of the entire world had attained during the preceding decade. A year later it had reached the sum of $56,000,000, and it was in that year that a similar discovery of placer gold was made in New South Wales, which was followed shortly by a still more important find in the colony of Victoria. New mines were also discovered in Russia during this period, and as all these discoveries were attended by great public excitement and heavy immigration the new mines were so well worked that the production of Australia and New Zealand soon aggregated $65,000,000, while that of Russia alone was in excess of $25,000,000.

The finding of the Comstock lode in Nevada was the next great discovery of the precious metal. This fissure vein, which was fully four miles long, was in rock of the Tertiary Age, and was situated at the base of Mt. Davidson, in the Virginia range, an offshoot of the Sierra Nevada. In the central part of the fissure its width is about 3,000 feet, while the gangue, or veinstone, is quartz, not uniformly distributed in the fissure, but coagulated in large bodies commonly known as "bonanzas." Apparently the metal had been deposited in this place in solution, while some idea of the tremendous magnitude of the deposit may be obtained from the fact that, since 1861, the year when it was first scientifically worked, the Comstock lode has yielded more than $350,000,000 of bullion. At the value ratio of 1 to 16.40 per cent. of the bullion produced was gold, while 60 per cent. was silver. As the richest ore bodies of the lode had been exhausted during the seventies, the annual yield gradually declined until, in 1882, it was less than $1,500,000, but as attention was then turned to the working of such lower-grade ores as had previously been neglected, the annual production gradually increased until it had again attained a figure of several millions.

It was about this time (1884) that there was discovered in the Witwatersrand of the Transvaal a deposit of gold that was destined to surpass in magnitude, not the Comstock alone, but every other find of the precious metal that the world had ever seen. Here the country rock is a bed of sandstone, interlaminated with deposits of conglomerate, known to the Dutch as "banket." It is this conglomerate that carries the gold, the average being 10 pennyweights per ton of material. Borings to the depth of 3,500 feet, however, have found the proportion of gold in this reef undiminished, while the outcroppings of the reef have been traced for a distance of 40 miles. The working of these mines gave the Transvaal a gold production of $78,070,761, in 1898. Then came the interruptions due to the war with Great Britain, in 1899, and this, with other disturbances, made a full resumption of the work impossible prior to about 1904, although it is believed that the output of the Rand willl yet equal the sum of $100,000,000.

The most surprising discovery of modern times, however, was the finding of the gold placers of the Klondike, in 1894. As the ground underneath which this gold is found is perpetually frozen, it is quite evident that these deposits must have been laid down at some age when the climate of that region was much warmer than it is at present. To procure this gold to-day, however, it is necessary to sink a shaft through the frozen ground by the use of hot boulders, after which the drift is run by building a fire against the face of the ground, the gravel which is then thrown out being left until summer, when it will thaw sufficiently to permit of washing and panning. It has been estimated that all the gravel which two men are able to throw out during the eight months of winter, can be washed by the same men in two months of the summer. In spite of the difficulties of mining and the cost of transportation the output of the Klondike region steadily increased until 1900, when it was estimated at more than $20,000,000. Since that time there has been a slight falling off in the product, which, in 1904, was figured as somewhat more than $16,000,000. Similar placer mines have also been discovered in the Cape Nome region of Alaska, and, in 1904, their output amounted to more than $9,000,000.

At the present time, however, the most important gold-bearing district within the borders of the United States is that at Cripple Creek, Col. This ore is a telluride, known to mineralogists as calaverite. The country rock is altered andesite, granite, or phonolite, containing thinly disseminated iron pyrites and tellurium minerals. The tellurium, at or near the surface, is oxidized, and the gold, when it is visible, exists as an ochre-like powder known as "mustard gold." The tellurium, through a process of roasting, is oxidized, and the gold thus set free in the metallic state is easily soluble by cyanide or chlorination. The estimated yield of the Cripple Creek district in 1904 was $24,000,000. The increase in the gold production of Australia during recent years has also been a remarkable factor in extending the world's output. During 1900, new workings were established in West Australia, and these, with the product of the older mines, produce an amount of gold, which, in 1904, was approximated at nearly $88,000,000.

The statistics showing the world's production of gold during the second half of the century, as compiled by the director of the mint, are as follows:

Period.	Annual average.	Total of period.
1851-1855	$132,513,000	$662,566,000
1856-1860	134,083,000	670,415,000
1861-1865	122,989,000	614,944,000
1866-1870	129,614,000	648,071,000
1871-1875	115,577,000	577,883,000
1876-1880	114,586,000	572,391,000
1881-1885	99,116,000	495,582,000
1886-1890	112,895,000	564,474,000
1891-1895	162,947,000	814,736,000
1896-1900	257,596,000	1,287,978,000
Half-century	$138,181,000	$6,909,040,000

The production of the world by single years from 1901 to 1904, inclusive, was:

Year.	Production.
1901	$263,374,800
1902	295,889,600
1903	325,527,200
1904	346,892,200
Total for 4 years	$1,231,683,800

The world's production of gold in 1904, according to the same authority, was divided as follows:

Counties.	Value.
Australia	$87,767,300
Africa	85,913,900
United States	80,464,700
Russia	24,803,200
Canada	16,400,000
Mexico	12,605,300
India	11,485,500
China	4,500,000
All others	22,942,300
Total	$346,892,200

The production of the United States and its territories during 1904 was divided as follows:

State, etc.	Value.
Colorado	$24,395,800
California	18,994,800
Alaska	9,160,500
South Dakota	7,024,600
Montana	5,097,800
Nevada	4,307,800
Utah	4,215,000
Arizona	3,343,900
Idaho	1,503,700
Oregon	1,309,900
All others	1,110,900
Total	$80,464,700

In concluding this review of the gold situation it may be interesting to note the manner in which new supplies of gold operate on prices. From a commercial point of view, gold stands for purchasing power, and yet people do not mark up the prices of their goods merely because some new gold mine has been discovered, but the fact that some men have $2 in their pocket where they had only $1 before creates a greater demand for goods, and it is to this increased demand that the advance in prices is due. It was in this way that the new supplies of gold acted when they brought about an increase in both prices and wages during the 20 years succeeding the discovery of the precious metal in California. This result was not brought about because the community was richer for the privilege of having two dollars instead of one with which to transact a given amount of business, but because, as Professor Cairnes shows, the distributions of the earnings of society was shifted by giving the advantage to wage-earners over rentiers and others having a fixed income. The former had more steady employment and better wages than before, while the latter were compelled to pay higher prices for the goods which they consumed without experiencing a corresponding increase in their income.

Gold Standard Bill, a short name for the act of 14 March 1900, «To define and Fix the Standard of Value, to Maintain the Parity of All Forms of Money Issued or Coined by the United States, to Refund the Public Debt, and for Other Purposes.» It provides that the dollar of 25.8 grains of gold, .9 fine, shall be the standard unit of value, and all forms of money issued or coined by the United States shall be maintained at a parity of value with this standard, and it shall be the duty of the secretary of the treasury to maintain such parity. All United States notes and treasury notes issued under the act of 14 July 1890 shall be redeemed in gold coin as above, and to secure this the secretary of the treasury is directed to set aside a reserve of $150,000,000 in gold coin and bullion, to be used for such redemption purposes only. If this reserve falls below $100,000,000 despite certain assigned methods of replenishing it, the secretary shall pledge the credit of the United States by issuing bonds at not exceeding 3 per cent interest, payable quarterly, exempt from all taxation. This is not to interfere with the legal-tender quality of silver money already in circulation. As fast as silver dollars are coined under previous acts, an equivalent amount of treasury notes shall be retired, and silver certificates issued instead. The coinage of subsidiary silver coins, and the recoinage of such as are out of circulation, is provided for. This act is not to prevent international bimetallism if it is found possible to secure a stable relation between gold and silver.

Goldau, gŏl'dow, a valley in Switzerland, in the canton of Schwyz, between Mount Rigi and the Rossberg. On 2 Sept. 1806 a landslide from Mount Rossberg destroyed the village of Goldau and three other villages situated in the valley, killing about 450 persons. A little village built in the valley, near the mines, is called Goldau. It has a population of about 490.

Goldchain, or **Golden Moss.** See STONECROP.

Gol'den, Colo., city, county-seat of Jefferson County; on Clear Creek, and on the Union P., the Denver, L. & G., and the Denver & G. R.R.'s; about 15 miles west of Denver. In the vicinity are deposits of coal and brick clay. The chief industries are smelting, the manufacturing of brick and pottery, and flour milling. A State Industrial School and a School of Mines are located here. Pop. 2,203.

Golden Age, among the Greeks and Romans was the reign of Saturn, whose blessings are described by Virgil in his eclogue addressed to Pollio. The Latin poet was borrowing from the Greek Hesiod who depicted the Golden Age as the patriarchal era of Saturn or Cronos. This was followed by the Silver Age of voluptuousness under Jupiter. Then came the Brazen or warlike age under Neptune. To this succeeded the Heroic Age under Mars, the Iron or utilitarian Age under Pluto, god of riches. The Golden Age in England was the reign of Elizabeth (1558–1603); in France under Louis XIV. The Golden Age of German literature included the period between Klopstock and Goethe (1750–1850). The Golden Age of Italian art was the famous 'Cinque Cento' extending from the life of Leonardo da Vinci (d. 1520) to Michelangelo (d. 1576).

Golden Beetle, one of the richly gilded beetles of the family *Chrysomelidæ* (q.v.).

Golden Bible, the Book of Mormon, which Joseph Smith, Jr., professed to have found in 1823. He declared that an angel appeared to him, and led him to the discovery. He was not, however, allowed to take up the gold plates on which the book was written until four years later. Joseph Smith was at first unable to read the «reformed Egyptian» characters in which the revelation was written until, in the same box with the plates, he discovered an instrument called Urim and Thummin, by the aid of which he translated the Golden Bible into English and published it in 1830, with the certificate of 11

men testifying that they had seen the plates of gold.

Golden Bull, a name given to several state documents; the principal ones are as follows:

1. Of Hungary, 1222, wrung from King Andrew II. by his nobles, just as Magna Charta was extorted from John of England. Andrew II. of Hungary, surnamed "Hierosolymitanus," was a feeble, self-willed, worthless king, like John of England. Its terms were:

The nobles and the Church were to be exempt from taxes.

The daughter of a noble without male heir shall inherit one fourth of his property.

No noble shall be obliged to follow the king in any foreign war.

The palatine (that is, mayor of the palace), shall be the supreme judge.

No foreigner to hold office or dignity without consent of the council of the realm.

The king shall not grant counties or offices of any kind in perpetuity.

If the king violates any of the laws in this bull, it shall not be treason to levy war on him.

This bull was so called because the attached seal was enclosed in a golden case or box. It is rather remarkable that one of the very first countries in Europe to effect the liberty of subjects should have been one of the last-born nations, the Huns of Hungary.

2. 'Bulla Aurea of the Empire,' 1356, published by Kaiser Karl IV. at the Diet of Nuremberg, and held the Magna Charta of Germany. It prevented a repetition of the contests which had hitherto arisen whenever a vacancy in the throne occurred; and regulated the functions, number and privileges of the electors. Called "golden" because the seal attached to the parchment was of gold instead of lead, or else that it was enclosed in a golden case.

It limited the number of electors to seven (three prelates and four lay princes). The prelates were the three Archbishops of Maine, Cologne, and Treves; the lay princes were the King of Bohemia, the Duke of Saxony, the Margraf of Brandenburg, and the Pfaizgraf of the Rhine. Their persons were declared sacred. Every question was to be decided by majority and without appeal.

Golden Calf, an idolatrous image, doubtless of Egyptian suggestion and symbolism, cast by Aaron from the earrings of the people, while the Israelites were encamped at the foot of Sinai, and Moses was absent on the Mount.

Golden Circle, Knights of the. See KNIGHTS OF THE GOLDEN CIRCLE.

Golden Cross, United Order of the. See UNITED ORDER OF THE GOLDEN CROSS.

Golden-crowned Sparrow, Thrush, etc., birds so named for some conspicuous yellow marking on the top of the head. The sparrow (*Zonotrichia coronata*) is a near relative of the white-crowned, or Peabody bird (q.v.), and is seen in the United States only in the spring and fall; it sings brilliantly in its Arctic and Alaskan breeding-home. The golden-crowned "thrush" is a warbler, bettter known as "oven-bird" (q.v.). The "wren" or "gold-crest" is a kinglet (q.v.).

Golden or War Eagle. See EAGLE.

Golden Eagle, Oriole, Plover, Shiner, Warbler. See EAGLE; ORIOLE; PLOVER; etc.

Golden-eye, or **Whistle-wing,** a duck (*Clangula clangula*) which breeds numerously in all northern regions, where its nest is made in holes in trees, or (in Lapland) in suitable boxes placed in trees. The American birds form a geographical race called *Americana*. During cold weather they appear in the United States and the middle districts of Europe, traveling about in small, watchful parties which escape swiftly on the least alarm, and arouse all other ducks within sound of the loud noise made by their wings. An European name is "garrot." The general color of the drake is white beneath, with head and sides of neck rich green, back and tail grayish-black, and the bill bluish-black; it has a round white spot before each eye, the iris of which is golden yellow, and two white bands on the wing; length about 19 inches. The female is ashy, with rufous head. In the Rocky Mountains and northward occurs a second somewhat larger species, Barrow's golden-eye (*C. islandica*), which differs prominently in the greater extent of the loral spot.

Golden-eyed Fly, a lace-winged fly (q.v.).

Golden Fleece. See ARGONAUTS.

Golden Fleece, Capture of the ("Argonautica"), an epic poem in four cantos, by Apollonius of Rhodes (235 B.C.), a contemporary of Ptolemy Philadelphus. Apollonius found all the elements of his poem in the legendary traditions of the Greeks; the expedition of the Argonauts being, next to the siege of Troy, the most famous event of the heroic ages. The third canto describes the conquest of the Golden Fleece, and the beginning of Medea's love for Jason, the development of which forms the finest portion of the poem. The Argonauts go through the most surprising adventures, and encounter perils of every description, before they are able to reach the port from which they started. These various events have allowed the poet to introduce brilliant mythological pictures such as his account of the Garden of the Hesperides. The work has been frequently translated, and is admittedly the masterpiece of Alexandrian literature. The 'Argonautica' of Valerius Flaccus is an imitation of that of Apollonius, regarded by most modern scholars as without originality or invention.

Golden Fleece, Order of, a celebrated order of knighthood in Austria and Spain, founded by Philip the Good, duke of Burgundy and the Netherlands, at Bruges, 10 Jan. 1429, on the occasion of his marriage with Isabella, daughter of King John I. of Portugal. The order was instituted for the glory of the saints and the protection of the Church, and the fleece was probably assumed for its emblem as much from being the material of the staple manufacture of the Low Countries as from its connection with heroic times. The number of the knights was 31, and they themselves filled up vacancies by vote. This continued till 1559, when Philip II. of Spain held the last (the 23d) chapter of the order in the cathedral of Ghent; and subsequently Philip obtained from Gregory XIII. permission to nominate the knights himself. After the death of the last Hapsburg king of Spain in 1700, the Emperor Charles VI. laid claim to the sole headship of the order in virtue of his possession of the Netherlands, and, taking with him the archives of the order, cele-

brated its inauguration with great magnificence at Vienna in 1713. Philip V. of Spain contested the claim of Charles; and the dispute, several times renewed, was at last tacitly adjusted by the introduction of the order in both countries. The insignia are a golden fleece (a sheepskin with the head and feet attached) hanging from a gold and blue enameled flint-stone emitting flames, and borne in its turn by a ray of fire. On the enameled obverse is inscribed *Pretium laborum non vile*. The decoration was originally suspended from a chain of alternate flints and rays, for which Charles V. allowed a red ribbon to be substituted, and the chain is now worn only by the grand-master. The Spanish decoration differs slightly from the Austrian. The costume consists of a long robe of deep red velvet, lined with white taffetas, and a long mantle of purple velvet lined with white satin, and richly trimmed with embroidery containing fire-stones and steels emitting flames and sparks. On the hem, which is of white satin, is embroidered in gold, *Je l'ay empris* ("I have captured it"). There is also a cap of purple velvet embroidered in gold, with a hood, and the shoes and stockings are red. See Reiffenberg, 'Histoire de l'Ordre de Toison d'Or' (1830); and Zoller, 'Der Orden vom Goldenen Vlies' (1879).

Golden Gate, a channel at the entrance to San Francisco Bay, between the peninsula upon which is located San Francisco and the one upon which Sausalito stands. The average width is two miles, and the depth is sufficient for ocean steamers. It is guarded by Forts Pointe and Mason, both on the south shore, and by a fort on Alcatraz Island. The name was given to this channel by Drake, about 1578.

Golden Hind, The, one of the two vessels in Sir Humphrey Gilbert's colonizing expedition of 1583. Gilbert's own vessel was the Squirrel, and he went down with it in a storm. The Golden Hind, Capt. Edward Hales, returned to England with the news.

Golden Horn, the harbor of Constantinople, an inlet of the Bosporus; so called from its shape and beauty. See CONSTANTINOPLE.

Golden House of Nero, a palace which Nero erected for himself at Rome after the disastrous fire of 64 A.D. This palace stretched from the Palatine across the level area on which the Flavian amphitheatre was afterward built to the foot of the Esquiline. According to Tacitus, whose virulence is often unjust, Italy and the provinces were plundered to gratify the emperor's love of magnificence in the erection of this structure. Gold and precious stones blazed on its walls; the grounds around it were variegated with meadows, lakes, and shady woods, and it was considered one of the wonders of the Roman empire.

Golden Mole, or **Cape Mole**, a South African insectivore with fur showing golden iridescence. It has the habits of a mole, no external ears or tail, and the eyes covered with skin; but a greater structural resemblance to the potamogales (q.v.). Five species constitute the family *Chrysochloridæ*, differing from moles (q.v.) most markedly in the fact that the fore-feet are adapted for digging by the development of the middle toe into a powerful tool, and by a hollowing inward of the chest. The best known species is *Chrysochloris trevelyani*, about six inches long.

Golden Oriole, commonly known as the Baltimore oriole, an American bird (*Icterus galbula*), closely allied to the *Ploceidæ*, weaving birds of Asia. Its nest is skilfully constructed so as to hang in the form of a long slender pouch from the extremity of a bough. Its plumage is brilliantly contrasted in color, and as black and yellow were the armorial colors of Lord Baltimore it was named in early colonial days after that nobleman. It is found in the hot months as far north as the coast of New Brunswick, and westward from the Saskatchewan River to Texas and northern Louisiana. In winter it migrates to Panama and the West Indian Islands. It is a powerful and delightful songster. Its eggs are from 4 to 6 in number and hatch in 14 days. The golden oriole is the farmer's friend and destroys many insect pests which are destructive to vegetation.

Golden-rod (*Solidago*), a genus of plants belonging to the *Compositæ*, containing about 85 species, most of them natives of North America, where their brilliant yellow flowers are very conspicuous in the autumnal months, especially in Canada and the northeastern United States. Two or three species are found in Europe, and a few in South America and Mexico. They are perennial, chiefly herbaceous, with simple undivided leaves, and bear numerous small flowers, disposed in spikes or panicles. Among the marked forms of inflorescence are the pyramidal panicle of numerous, one-sided, scorpioid racemes, well illustrated by the *S. canadensis* and *S. rugosa;* the almost level cyme of the *S. rigida;* and the dense thyrsus-like cluster of the *S. speciosa.* The florets of the ray are about five in number, and yellow, the *S. bicolor* excepted, which has whitish rays. The dried leaves of the sweet-scented or anise-scented golden-rod (*S. odora*) have been used as a substitute for tea. This plant yields an aromatic oil with tonic properties. In Europe the different species are cultivated in gardens for ornament; one, the Aaron's rod (*S. virgaurea*), is common in Great Britain. The Alpine golden-rod is found on the summits of mountains in Maine, New Hampshire, and northern New York, and also in Europe. The sea-side or salt-marsh golden-rod (*S. sempervirens*) is an especially showy species; and the "yellow-weed" (*S. canadensis*) sometimes attains a height of eight feet. Some species found in New Zealand and St. Helena attain to the dimensions of trees.

Golden Rose, a rose of gold, or gilded, blessed by the Pope on the fourth Sunday of Lent and sent to some sovereign or other person who is known for his or her loyalty to the Holy See. It is sometimes sent to noted churches or sanctuaries.

Golden Rule, the rule laid down by Jesus in the Sermon on the Mount, and stated by him to be the law and the prophets — that is, a summary of their teaching: "Therefore all things whatsoever ye would that men should do to you, do ye even so to them" (Matt. vii. 12). This rule had already been "examined and adopted as a standard of ethics by westerns like Socrates and easterns like Theng-tsen, the disciple and friend of Confucius, some centuries before the birth of Christ."

Golden Seal, Orange-root, Yellow Puccoon, or Yellow Indian Paint, a ranunculaceous perennial plant (*Hydrastis canadensis*) of wooded regions throughout the eastern United States, which sends up in early spring a hairy stem about a foot high, with large, deeply lobed leaves and a single greenish-white flower, followed by a head of crimson berries which resemble a raspberry. The root-stock is gathered by country people, especially in the South, for the sake of its thick orange-yellow bark from which a drastic and tonic medicine is made.

Golden State, California, so named on account of its gold deposits.

Golden Spur, Order of the, a papal order of knighthood, whose foundation has a legendary origin in Constantine the Great, or Pope Sylvester. Its institution can be traced historically to Pope Paul IV., 1559. The title of the members is "Count Hospitalers of the Lateran." The right of bestowing the order is vested in other prelates and kings beside the Pope. When it languished, Gregory XVI. revived it in 1841. It is intended to be bestowed as a recognition of conspicuous merit in personal character, science and art, and for services done to humanity and the Holy See. The badge is a gold Maltese cross with white enameled surface, to which a pendant spur is attached. On one face of the cross is a bust of Sylvester, with the inscription, *Sanctus Silvester Pont. Max.* (St. Sylvester, Pope). On the reverse is engraved "MDCCCXLI. Gregorious XVI. restituit" (Gregory XVI. restored it in 1841). The order has three grades; the ribbon is red with black stripes.

Golden Wasp, or **Gold Wasp,** a cuckoo-fly (q.v.)

Golden Wedding. See DIAMOND WEDDING.

Golden-winged Woodpecker. See WOODPECKER.

Goldfinch. (1) The familiar North American black-winged "yellowbirds" or "wild canaries" of the genus *Spinus,* the best known of which is the eastern thistle-bird or lettuce-bird (*S. tristis*), whose wave-like flight across the fields, each male singing sweetly in its course, forms one of the most pleasing incidents of a rural stroll. These little finches are bright golden-yellow, with the cap, wings, and tail black in the adult male; while the female and immature young are gray-brown and yellowish; and in autumn the male discards his conspicuous dress and assumes the plain attire of his mate. At this season they collect in flocks and remain together during the winter, seeking the seeds of the meadow-grasses and roadside weeds, especially thistles, and often coming near the house and barn. Their summer food includes more soft material, and they gather many caterpillars for their young. The goldfinch is one of the latest birds to make its nest, delaying until midsummer to fabricate the soft cup of hempen and downy materials which is lodged usually in some crotch of a village shade-tree, and contains half a dozen spotless bluish eggs. Several other species dwell in the western United States and southward. (2) The small European finch (*Carduelis carduelis*) to which the name first belonged, and whose habits are much the same as those above described, but which is more varied in plumage. The bill is horn-color, the tip black and the base encircled with crimson; nape of neck white; top of head, shoulder of wing and a part of the quills, black; remainder of wing dull yellow; back and rump dusky brown; under surface dull white. Its nest is neatly built of moss, twigs, roots, etc., lined with wool, is situated in bushes, hedges, or apple-trees, and the eggs are spotted with purple and brown. This finch is one of the sweetest singers of Europe, a favorite cage-bird, and the one most often taught pretty tricks; it is the most useful decoy in bird-catching. Examples are to be found in bird-stores all over the world; and in the neighborhood of New York many have escaped and are living wild in the parks and environs.

Goldfish, a carp (*Carassius auratus*), highly cultivated long ago in China as a domestic fish for the sake of its rich red-gold color, developed out of an originally much duller hue. It was introduced into England in 1728, and has spread over all of Europe and is naturalized in many waters of the United States as well as everywhere kept in household aquaria. The young are dark-colored, assuming the golden hue later in life, and sometimes losing it in old age, when the fish becomes silvery. The "silver fish" is a mere variety, as are the so-called "telescope fish" with large protruding eyes and the Japanese "butterfly fish," in which anal and caudal fins become more or less markedly double. All of these varieties thrive well in confinement when furnished with favorable conditions in the aquarium (q.v.), but are liable to fungus diseases of the skin. Diseased fish will infect all in an aquarium, and the aquarium itself, so that in the case of an inexpensive glass globe it is better to throw the receptacle away; a large aquarium should be emptied and thoroughly treated with some fungicide (q.v.) before new and healthy fish are installed. These fish are bred for sale by some fish culturists in various parts of the United States, who must exercise care or their stock will revert toward the original unadorned type of the species.

Golding, Arthur, English writer and translator: b. probably at London about 1536; d. about 1605. He finished the translation of Philippe de Mornay's treatise 'Sur la Vérité du Christianisme' which was begun by Sir Philip Sidney and entrusted to his care, publishing it under the title 'A Woorke Concerning the Trewenesse of the Christian Religion, etc.' (1589). Beside making translations of the works of Calvin and Beza, he also translated the first four books of Ovid's 'Metamorphoses' (1567).

Goldmark, Karl, Austrian composer: b. Keszthely, Hungary, 18 May 1830. He studied at the Vienna Conservatory. His first composition of note was the overture, 'Sakuntala' (1858); his first opera the 'Queen of Sheba' given at Vienna in 1875. His other works include: 'Merlin,' an opera performed for the first time at the Metropolitan Opera House, New York, in 1887; the overtures 'Prometheus,' 'In Spring,' and 'Penthesilea'; and the symphony 'The Country Wedding.'

Goldoni, gŏl-dō'nē, **Carlo,** Italian writer of comedies: b. Venice 1707; d. Paris 8 Jan. 1793. He early showed a taste for theatrical representations, reading every dramatic produc-

tion of which he could obtain possession, especially the works of the popular comic poet Cicognini, and, when scarcely eight sketched a comedy, which excited the wonder of his relatives. His father, a physician then practising at Chiozza, destined him for the medical profession, and took him occasionally to visit his patients. But Goldoni, dissatisfied with this study, obtained permission to study law in Venice. Soon after, however, a relative procured for him a place in the Papal College at the University of Pavia, from which he was expelled for writing an abusive satire. His father died in 1731, and from this time Goldoni lived an unsettled and wandering life, resorting to various means to make a livelihood, but usually living as the companion of strolling players in a continual scene of dissipation and intrigue until 1736, when he married and removed to Venice.

Goldoni's merits in reforming the Italian theatre cannot be mistaken. Many of his numerous pieces still retain possession of the stage in his native country, and, in translations, of the stages of foreign countries. Among the numerous editions of his works, that published at Venice in 1788 and 1794–5, in 44 volumes, is the most complete; and that published at Florence in 53 volumes in 1827 the most elegant. Translations and imitations of some of his works have been made in French, German, and English. Goldoni wrote memoirs of himself in French, in which he also composed two comedies, one of which, 'Le Bourru bienfaisant,' was produced at Fontainebleau and Paris in 1771 with great applause, and has maintained itself on the stage. See 'Memoirs of Carlo Goldoni,' translated by Black with essay by W. D. Howells (1877); Rabany, 'Le Théatre et la Vie en Italie au XVIIIème siècle' (1896).

Golds'boro, N. C., city, county-seat of Wayne County; on the Neuse River, the Atlantic & N. C., the Southern, and the Atlantic C. L. R.R.'s; about 80 miles north of Wilmington, and 50 southeast of Raleigh. It is the site of a State Normal School for colored teachers, the Eastern Insane Asylum, and the Odd Fellows' Orphanage. The chief manufactures are cotton, agricultural implements, cotton-seed oil, furniture, mattresses, and machinery. Pop. 5,880.

Goldsboro, Kinston, and Goldsboro Bridge, Engagements at. On 11 Dec. 1862, Gen. Foster, in command of the Department of North Carolina, set out from Newbern for the purpose of taking Goldsboro and breaking the railroad that connected Richmond with the railway system of the South and Southwest, and then forming a junction with the Union forces at Suffolk and Norfolk, Va. He had four brigades of infantry, a regiment of cavalry, and seven batteries and two sections of batteries, in all about 11,500 men and 40 guns. He reached Southwest Creek on the 13th, to find the bridge destroyed and his passage disputed by about 400 Confederates, with three guns. The 9th New Jersey and 85th Pennsylvania soon routed this force, capturing one gun, and Foster pushed on toward Kinston, skirmishing heavily on the way, and when within a mile of the place, 14 December, encountered a force of 2,000 men under Gen. Evans, posted between the Neuse River and a deep swamp. After a sharp fight Evans was driven across the river, firing the bridge behind him; but the fire was extinguished and 400 prisoners and six guns were taken. Evans retreated through Kinston, reformed his command two miles beyond, and withdrew toward Goldsboro. Foster followed, had a successful engagement on the 16th, at White Hall and, when nearing Goldsboro 17 December, was checked by a heavy force under Gen. G. W. Smith at Goldsboro Bridge. Foster succeeded, however, in destroying the bridge of the Weldon & Wilmington Railroad over the Neuse, also several other bridges, and about six miles of railway, and retreated somewhat rapidly to Newbern, having lost during his eight days' campaign 92 killed, 487 wounded, and 12 missing. The Confederate loss was 71 killed, 268 wounded, and 496 prisoners. The prisoners were paroled.

Union Occupation of Goldsboro.— After the capture of Wilmington by Gen. Schofield 22 Feb. 1865, his next objective point and final destination was Goldsboro, where it had been arranged that he should unite forces with Gen. Sherman, who was marching north from Savannah. Forces were assembled at Newbern, and the march began on 1 March. Kinston was occupied 14 March, after some days' sharp fighting. (See KINSTON, BATTLE OF.) The railway and bridges were repaired, and Schofield entered Goldsboro with little opposition on the 21st, and two days later Sherman joined him. Consult: 'Official Records,' Vol. XVIII.; Cox, 'The March to the Sea.'

E. A. CARMAN.

Golds'borough, Louis Malesherbes, American naval officer: b. Washington, D. C., 18 Feb. 1805; d. there 20 Feb. 1887. In 1827 he rescued the English brig Comet from a Greek pirate whose force was five times greater than his own. In 1861 he was put in command of the North Atlantic blockading squadron and the advice given by him at this time resulted in the Burnside expedition and the capture of Roanoke Island with various other positions of strategic importance in North Carolina. He became rear-admiral in 1862.

Goldschmidt, Hermann, hĕr'män gōld'-shmĭt, German painter and astronomer: b. Frankfort-on-the-Main 17 June 1802; d. Fontainebleau, France, 10 Sept. 1866. He became a pupil of Schnorr and Cornelius, and went in 1836 to settle at Paris, where he exhibited many pictures, among which may be mentioned: 'Une femme en costume algérien'; 'Le jeune Florentin'; 'La poésie'; 'La Sibylle de Cumes'; 'L'offrande à Venus'; 'Cléopatre'; 'Vue de Rome'; 'Mort de Roméo et Juliette'; etc. In 1847 he suddenly conceived the design of becoming himself an astronomer, and in this new profession he rapidly became known as one of the ablest observers of celestial phenomena. Between 1852 and 1861 he discovered 14 telescopic planets, namely, Lutetia, Pomona, Atalanta, Harmonia, Daphne, Pales, Doris, Eugenia, Europa, Alexandra, Nysa, Melete, Danaë, and Panope. In 1863 his sight began to fail, making it impossible for him to continue his observations.

Goldschmidt, Jenny Lind. See LIND, JENNY.

Goldschmidt, Meier Aaron, Danish novelist and publicist: b. Vordingborg 26 Oct. 1819;

d. Copenhagen 15 Aug. 1887. He entered journalism when quite young, edited the comic paper 'Corsaren' (1840–6), and in 1847 founded a monthly publication in which he discussed the political movement of the time, and showed himself a strong advocate of constitutional freedom. His first novel, 'A Jew,' appeared in 1845; other novels of his are: 'Homeless' (1853); 'The Heir' (1865); and 'The Raven' (1867); he also wrote a few dramas, and his autobiography (1877). His novels are most remarkable for the skill with which he pictures the life of the Jews.

Goldschmidt, Otto, English composer: b. Hamburg, Germany, 21 Aug. 1829. He was a pupil of Mendelssohn and Hauptmann at the Leipsic Conservatory, became a resident of England in 1858, was appointed a professor in the Royal Academy of Music in 1863 and its vice-principal in 1866. From 1876–85 he was first musical director of the Bach Choir. His compositions include the oratorio 'Ruth' (1867), and he also edited with Sterndale Bennett 'The Chorale Book for England.' In 1852 he married Jenny Lind (q.v.).

Goldsmith, Oliver, Irish poet and miscellaneous writer: b. Pallas, County Longford, Ireland, 10 Nov. 1728; d. London 4 April 1774. He was the son of Rev. Charles Goldsmith, a clergyman of the Established Church. He studied at Trinity College, Dublin, 1744–9, and after abortive attempts to take orders, and much reckless dissipation and imprudence, went to Edinburgh to study medicine in 1754. He remained there 18 months during which he acquired some slight knowledge of chemistry and natural history. At the end of this period he removed to Leyden. After studying at that university for about a year, he left it in February 1755 with only one clean shirt and no money in his pocket, to make the tour of Europe on foot, and actually traveled in this way through Flanders, part of France, Germany, Switzerland, and Italy. It was probably at Padua that he took a medical degree, as he remained there six months; but the death of the uncle who had hitherto repeatedly rescued him from his various straits, occurring while he was in Italy, he was again obliged to travel on foot to England, and reached London in 1756 with a few pence in his pocket. He then took lodgings in London to follow the profession of an author. He conducted a department in the 'Monthly Review'; wrote essays in the 'Public Ledger' (afterward published under the title of the 'Citizen of the World'), and a weekly pamphlet entitled the 'Bee.' In 1761 he was introduced to Dr. Johnson. In 1764 he appeared as a poet by the publication of his 'Traveler.' The celebrity which this poem procured its author was the cause of his introduction to the most eminent literary characters of the day. In 1766 appeared his well-known 'Vicar of Wakefield,' which at once secured merited applause. In 1768 his comedy of 'The Good-natured Man' was acted with but indifferent success, and he applied himself to the more certain labor of a 'Roman history,' of which he afterward published an abridgment. His poetical fame was greatly enhanced by the publication of his 'Deserted Village' in 1770, and in 1771 appeared 'The Haunch of Venison,' a poem, and a 'History of England' in four volumes. In 1773 he produced his comedy of 'She Stoops to Conquer,' which was completely successful. He did not, on this account, neglect compilation, and, besides a 'Grecian History,' he supplied the booksellers with a 'History of the Earth and Animated Nature,' composed in a manner both amusing and instructive, although the scientific acquirements of the author were not sufficient to guard against numerous errors. He was buried in the Temple Church, but a monument was erected to his memory in Westminster Abbey, with a Latin inscription by Dr. Johnson. The manners of Goldsmith were eccentric, even to absurdity; no writer of his time possessed more genuine humor, or was capable of more poignancy in marking the foibles of individuals, of which faculty his unfinished poem of 'Retaliation' furnishes a very happy specimen. As a poet, his 'Traveler' and 'Deserted Village' have given him a deserved reputation; and his 'Vicar of Wakefield' is one of the best known and most esteemed of English 18th century novels. See lives by Forster (1848), Irving (1849), Black (1879), Dobson (1888).

Goldsmith Beetle, an attractive northern dung-beetle (family *Scarabaeidæ*) measuring nearly an inch in length and shining like burnished gold. It is most abundant during May and June, flying principally at night; and, although it feeds on the foliage of various shade and fruit trees, seldom does much harm. The name is extended by entomologists to all scarabs of the sub-family *Rutelinæ*.

Goldthread, a low smooth ranunculaceous herb (*Coptis trifolia*), closely related to hellebore, whose evergreen leaves are all basal, long-petioled, and divided into three serrate broadly obovate parts; and the flowers small and white on scapes. The root consists of long, bright, yellow, bitter threads. This plant contains a white alkaloid called coptine, and a tea made of it is tonic. It grows in boggy woods throughout all northern regions. See also Coptis.

Goldtit. See Verdin.

Goletta, gō-lĕt'tä, Africa, the port of the city of Tunis, from which it is 11 miles north. In the new quarter are the bey's palace, a large dock, and an arsenal defended by a battery. Pop. about 3,000.

Golf, anciently known as Goff, Gouff, or Gowff, a game of Dutch origin, but generally identified with Scotland, where as early as 1457 the local Parliament inveighed against its abuse, and whence it has become popularized throughout the English-speaking world. The word, derived from the German *Kolbe,* in Dutch *Kolf,* signifies a club. *Kolf,* resembling golf, is a very ancient pastime in Holland and Belgium, where it is usually played on the ice.

The modern game of golf is played with clubs and balls on specially prepared courses called *links,* generally laid out on open suitable grounds. In its aristocratic development, golf is an expensive game, requiring facilities in the way of grounds and attendance and leisure which do not fall in the lines of everyone; in its practical features, however, it is democratic, and may be cultivated in every village and on every farm where spare ground is available. The simplicity of the game is attractive to beginners, but with a little experience the beginner learns how necessary are

practice, skill, and judgment to make one play well enough to be classed as a good golf player. The prime necessity is plenty of room. The ground best suited for the purpose is a reach of undulating country with a sandy soil, short, crisp turf, and plenty of holes or ruts, the latter forming the *hazards* — natural obstacles — or *bunkers* — artificial obstacles — necessary to prevent the game from being too easy. The *links* should not be less than three miles round nor more than five. Throughout it are distributed 18 artificial holes at any distance from 100 to 500 yards apart. The holes are 4½ inches in diameter, and each is surrounded with a *putting green,* a space 60 feet square and made as smooth as possible to enable the player to aim with accuracy. The other requisites are two small balls about two inches in diameter and made of gutta-percha, and a number of *clubs* adapted to the various contingencies likely to arise.

There are two styles of clubs, the wood and the iron; these consist of a long wooden handle, preferably of hickory, securely attached to a head of beech wood, or of steel as the case may be. Altogether there are 19 shapes of clubs, but six are usually sufficient for a player's needs. The different clubs are used under different circumstances; for example, the chief wooden-headed clubs are the *driver* and the *brassy,* the first being used for driving the ball a long distance, and the latter, which is shod with brass, being employed in special situations, as when the ball is in a hollow. The club called the *putter,* used when the ball is near the hole, has the head either of wood or of iron. The iron-headed clubs are the *cleek,* the *iron,* the *mashie,* and the *niblick,* all adapted for special purposes. The clubs are used for driving the balls into the holes, and the object of the player is to get his ball into all the holes successively with the fewest possible strokes. When played by two persons the game is called *singles;* when played by four persons in pairs, it is called *foursomes.* There are two chief methods of playing the game, known as *match play* and *medal play.* In the former, two players are usually pitted against each other. Attended by their *caddies,* boys carrying the bags containing the clubs, the players start from the *teeing* ground where one of them begins the match by placing his ball on a small heap of sand, or on an artificial rubber cone, known as a *tee,* and driving it as near as possible to the first hole. A good driving stroke from a tee would be 200 yards. The record, made at St. Andrews, Scotland, is 280 yards. The other player does the same with his ball, after which the player whose ball is farthest from the hole plays again. They continue thus until both balls have been holed. The player who takes the fewest strokes to do this is said to win the hole and counts one, and if both have taken the same number of strokes the hole is *halved* and neither counts. Having *holed* his ball the player takes it out, *tees* it again, and starts out for the next hole. Much of the interest of the game depends on the skilful play required to avoid the *hazards* and *bunkers* scattered over the course, or to get one's ball out when it lands in a difficult spot. In *medal play* the winner is the player who goes the round of the course in the fewest possible strokes irrespective of whether he had a majority of holes or not. Various modifications of these two modes of scoring are in use. A hole match may be won before the round is completed, as, for instance, when one competitor is four holes ahead with only three still to be played. When one player has a lead equal to the number of holes still unplayed, he is said to be *dormy* that number of holes; thus, a player when *dormy three* has a lead of three after playing the fourth last hole, in which case, though he may not win, he cannot lose. The central authority on the game in America regulating the various championships, etc., is the United States Golf Association organized 22 Dec. 1894, with which is now affiliated over 200 clubs throughout the country. Consult: Clark, 'Golf: A Royal and Ancient Game' (1899); Travis, 'Practical Golf' (1901); Richards, 'Royal Game of Golf' (1902).

Go'liad, Texas, city, county-seat of Goliad County; on the San Antonio River, and the Southern Pacific R.R., about 45 miles from the Gulf and 168 miles southwest of Galveston. Goliad gets its name from Hidalgo (q.v.), the patriot priest of Dolores, who in 1810 led the revolution in Mexico against Spain. When Goliad was founded the people did not dare to name it Hidalgo, so dropping the silent H and transposing the letters, they made the word Goliad. This place was the last site of the ancient mission of La Bahia del Espiritu Santo (1749). This mission was first founded at the place where La Salle built Fort Saint Louis in 1685. Goliad was the scene of a bloody contest (1812) between the so-called "Republican Army of the North," under Magee and Gutierrez, and the Mexicans. Here Magee died, evidently assassinated. In the Texas revolution (1835) Goliad was a point of strategical importance to the Texans. It was captured by Ben Milan and Collingsworth and became the base of military operations. The independence of Texas was declared here 20 Dec. 1835. Ira Ingram and Philip Dimmit were the leaders in formulating this declaration, and at the meeting there were 92 soldiers and all the citizens of the town. The official declaration of independence was made at Old Washington 2 March 1836. In Goliad, on Palm Sunday, 27 March 1836, the Mexican commander, Urrea, caused to be slaughtered 300 unarmed men who had surrendered, Fannin (q.v.) and his command. These defenseless men had been promised life and liberty before being marched out in squads and shot down like dogs. Urrea claimed he acted under orders from Santa Anna (q.v.). Afterward a rallying cry of the Texas troops under Sam Houston was "Remember Goliad." In 1902 Goliad was visited by a disastrous cyclone which swept away almost the whole town. Pop. 2,000.

Goliardery, gō'lĭ-är-dėr-ĭ, the name given to the *Carmina Burana,* a series of satirical Latin poems of the 13th century. They were the productions of the self-styled Goliardi, mediæval wandering students, disciples of the mythical Golias. While attacking the abuses and vices of the period, especially those existing in the Church, they glorified also the love of nature, women, and wine. This naturally antagonized the ecclesiastical mind which was prone to exaggerate into grave sins what ordinary men would consider as mere peccadilloes. From a classical standpoint the majority of the songs

are generally below criticism; from a moral point of view, many of them are vigorous and healthful, and are popular among German students of the present day. Consult: Schmeller, 'Carmina Burana' (1894); Symonds, 'Wine, Women, and Song' (1884).

Goli'ath Beetle, one of the huge scarabe beetles of the cetonian genus *Goliathus*, distinguished by their large size, the horny processes on the head of the male, and the teeth-bearing lower-jaws. The name specifically belongs to *G. giganteus* of the Gold Coast, which is four inches long, and is chalky-white broadly and variously marked with black. It feeds almost entirely on the sap of trees. Compare HERCULES BEETLE.

Golomyn'ka, or **Oil-fish**, a goby-like fish (*Comephorus baikalensis*) found only in Lake Baikal, about a foot long, destitute of scales, and very soft, its whole substance abounding in oil, which is obtained from it by pressure. It is never eaten.

Golosh'es (Fr. *galoche*, "a patten, clog, or wooden shoe") (1) a kind of wooden clog, with a joint at the instep and upper leathers like those of very low shoes, worn in the Middle Ages. (2) India-rubber overshoes first manufactured in the United States and introduced into Great Britain about 1847. The term is now restricted to the latter meaning, and is used mostly in England, very rarely in the United States. See INDIA-RUBBER; RUBBER MANUFACTURES.

Go'marists, the ultra Calvinistic party in the Dutch National Church, so called from their leader, Francis Gomar (q.v.).

Gomez, gō'mĕs, **Antonio Carlos**, Brazilian composer: b. Campinas 11 July 1839; d. Pará September 1896. He was a pupil at the Milan Conservatory, and had his first opera, 'A noite do castello,' presented at Rio de Janeiro in 1861. His 'Se sa minga' gained notable success at La Scala, Milan, in 1867, and was followed by a series of varying merit, including: 'Guarany' (1870); 'Salvator Rosa' (1874); and 'Lo Schiavo' (1889). He wrote the hymn 'Il saluto del Brasile' for the Centennial Exhibition at Philadelphia (1876), and a cantata, 'Colombo,' for the Columbian Exposition (1893). He was director of the Conservatory of Music at Pará, Brazil, 1895–6.

Gomez, Estevan, ĕs'tā-vän, Portuguese navigator: b. about 1474; d. about 1530. He became an expert pilot in the Portuguese East Indian fleet, sailed in 1519 on Magellan's voyage as pilot of the Trinidad and was later transferred to the San Antonio, on board which he contrived a successful mutiny and then sailed for Spain. There he was imprisoned, but in a short time set free. It appears that in 1524–5 he was sent by Charles V. to explore the eastern coast of what is now the United States and discover a northern route to the Orient. A map executed in 1529 by Diego Ribeira, a cosmographer, marks the territory included between the present States of Rhode Island and New Jersey, Tierra de Gomez.

Gomez y Baez, ē bä'ĕs, **Maximo**, Cuban soldier: b. Bani, Santo Domingo, 1831; d. Havana, Cuba, 17 June 1905. When Santo Domingo revolted against Spain he served as lieutenant of cavalry in the Spanish army; and when the freedom of the island was declared he went with the Spanish army to Cuba, but left the army because Gen. Villar maltreated some Cuban refugees. In 1868 he joined the Cuban insurrection, and through his ability and daring soon rose to a position of prominence, being in several successful engagements; though deprived of his command at one time, he was soon recalled, and rose to be major-general. On the failure of the rebellion, he left Cuba and settled on his farm in Santo Domingo. Returning to Cuba, he was influential in bringing about the insurrection of 1895–8, and was made commander-in-chief of the Cuban army. His policy was to avoid open engagements and to drive the Spaniards out by devastating the island and constant harrassing of their troops. When the American landed in Cuba (1898) he willingly co-operated with them. On 24 Feb. 1899 he marched into Havana at the head of his soldiers and was received by the United States authorities. In March of the same year he was deposed from his command by the Cuban Assembly on account of his accepting $3,000,000 for his army from the United States. He assisted the American governor-general in his work in the island, and was at one time suggested as a candidate for the presidency of the Cuban republic.

Gomez-Ferias, fā-rē'äs, **Valentin**, Mexican statesman: b. Guadalajara 14 Feb. 1781; d. Mexico City July 1858. He studied in the University of Guadalajara, was appointed a professor there in 1810, was a liberal member of the first constituent congress, was elected vice-president with Santa Anna, and in consequence of the latter's absence, assumed executive powers 1 April 1833. His administration was strongly opposed by the Clerical party; in 1835 a constitutional congress refused to acknowledge his authority, and he was exiled. He returned in 1838; in 1840 led an unsuccessful revolt, and again was banished. Having returned in 1845, he was elected vice-president in 1846; later a deputy to Congress, and was appointed postmaster-general under Alvarez.

Gompers, Samuel, American labor leader: b. London, England, 27 Jan. 1850. A cigar-maker by trade, he has been known as a zealous worker in the cause of the rights of labor, since his boyhood. He has been active in efforts to organize the working people, and was one of the founders of the American Federation of Labor, of which he is president. He has exerted much influence and has put forth various pamphlets on the labor question and the labor movement in general.

Gomuto, gō-moo'tō, a name in the East Indies for the stiff, strong fibre obtained from the leaves of the sugar-palm or areng (*Arenga saccharifera*) and hence often applied to the tree itself. This fibre, also called "ejow," is extensively used for ropes on account of its extraordinary strength and durability. At the base of the older leaves grows a woolly material called "baru," useful as stuffing for cushions, calking seams, and similar purposes. See PALM; SAGO.

Gonaives, gō-nä-ēv', Hayti, town on the west coast on the bay of the same name, 65 miles north-northwest of Port au Prince. It

has an excellent harbor, a naval and military hospital, and a mineral spring. The exports are cotton, coffee, salt, and mahogany. Pop. 18,000.

Gonas. See HOTTENTOTS.

Goncourt, de, dė gôṅ-koor, EDMOND LOUIS ANTOINE HUOT: b. Nancy 26 May 1822; d. 16 July 1896; and JULES ALFRED HUOT DE: b. Paris 17 Dec. 1830; d. Auteuil 20 June 1870; French novelists. The Goncourt brothers were not men of letters but artists primarily, and in 1849 they set out, knapsack on back, to traverse France for drawings and water-colors. Their note-books made them writers as well as artists, and already in 1852 they had commenced that literary partnership which continued nearly 20 years. Their earliest serious works were a group of historical studies upon the second half of the 18th century, intended to be an effective resurrection of its habits of life, manners, and costume, which, though elaborate in detail lacked calm and impartial historical sense, breadth of view, and creative grasp of character. These books were: 'Histoire de la Société Française pendant la Révolution' (1854), 'La Société Française pendant le Directoire' (1855); 'Portraits intimes du XVIII. Siècle' (1856–8); 'Histoire de Marie Antoinette' (1858); 'Les Maîtresses de Louis XV.' (1860), 'La Femme au XVIII. Siècle' (1862), and 'L'Amour au XVIII. Siècle' (1875); 'Gavarni' (1873), and 'L'Art au XVIII. Siècle' (1874). The more important work of the De Goncourt brothers was their novel writing; their conception of the novel was that it should be an imaginative attempt to grasp and summarize the results of close observation; their aim was to paint manners by taking the traits in which one man resembles a class; hence they select as generic types only persons of moderate faculties. Their novels include: 'Les Hommes de Lettres' (1860), republished in 1869 under the title 'Charles Demailly'; 'Sœur Philomène' (1861); 'Renée Mauperin' (1864); 'Germinie Lacerteux' (1865); 'Manette Salomon' (1867); and 'Madame Gervaisais.' After the death of his brother, Edmond wrote the 'La fille Elisa' (1878), a novel; 'L'Œuvre de Watteau' (1876); 'L'Œuvre de Prudhon' (1877); and 'La Maison d'un Artiste' (1881). Consult: Bellock and Shedlock, 'Edmond and Jules de Goncourt.'

Gon'dola, a long narrow boat used on the canals of Venice. The middle-sized gondolas are upward of 30 feet long and 4 to 5 feet broad; they always terminate at each end in a sharp point, which is raised perpendicularly to the ordinary height of a man. They have a well-furnished cabin amidship. They are propelled by rowing; the oarsman or gondolier stands in the stern facing forward; sometimes there are two gondoliers, the second one standing in the bow. They are usually painted black in accordance with an old law of the Venetian republic, which prescribed that all gondolas should be black, except those of the doge and the foreign ambassadors. The gondolas were until recently the only means of getting about the city; now steam-launches, acting as omnibuses, are also used.

Gonds, an aboriginal race of British India, a remnant of the Dravidians who were driven out of the plains by an early Aryan invasion. They took refuge in Gondawana, a territory pretty well identical with what are now called the Central Provinces. Here their seat was the Satpura plateau, between the rivers Pain Ganga, Pranhita and Godavari on the west and the Indravati on the east, while they were bordered on the north by the river Nerbudda. They still retain their dominion in the mountain forests of Orissa. Since 1781 they have become subjects of England, and their speech and religion have more and more conformed to those of the Hindu. Their language, known as Gondi, is a Dravidic branch of the Dekhan language. The contact with British civilization has not influenced them much in their highland lurking places. Their religion consists in a worship of many spirits, and they are enslaved to their priests. They have distinct physical characteristics which differentiate them from the Hindus. They are swarthy, almost black in complexion; their hair is long and black, though sometimes it is of a ruddy tinge. In countenance they have a broad forehead, and small, deep-set eyes. They wear little clothing. One of their clans, the Moria, tattoo their faces, and shave their heads. They do not like agriculture, but are much in demand as builders and roadmakers. According to the census of 1891 the total number of Gondi-speaking people in British India is 1,380,000, the majority of whom are found in the Central Provinces, the remainder being scattered through Bera and Hyderabad. Consult: Forsyth, 'Highlands of Central India' (1889); Dalton, 'Descriptive Ethnology of Bengal' (1872); Risley, 'Tribes and Castes of Bengal' (1892); Williamson, 'Gondi Grammar and Vocabulary.'

Gon'falon, an ensign or standard which used to be borne by the chief magistrates of many Italian cities, as Florence and Lucca. These magistrates were hence called gonfaloniers. The title of gonfalonier was also sometimes bestowed by the Roman Catholic Church on persons of distinction, who were called gonfaloniers of the Church.

Gong, an instrument of Chinese origin, made of a mixture of metals and shaped into a basin-like form, flat and large, with a rim a few inches deep. The sound of the gong is produced by striking it, while hung by the rim, with a mallet, which puts the metal into a state of vibration, and produces a loud piercing sound. The modern gong or gong-bell is sounded by striking it with a hammer operated by machinery.

Góngora, Luis de Góngora y Argote, loo-ēs' dā gōn'gō-rä ē är-gō'tā gōn'gō-rä, Spanish lyric poet: b. Cordova, 11 July 1561; d. there 23 May 1627. About 1614 he entered the Church, and became a prebendary of the cathedral at Cordova, and eventually chaplain to Philip III. Góngora's earlier writings — sonnets on a great variety of subjects, lyrical poems, odes, ballads, and songs for the guitar — are inspired with much true poetic feeling. His later works, consisting for the most part of longer poems, such as 'Solidades' (or Solitary Musings), 'Polifemo,' 'Pyramo y Thisbe,' are executed in an entirely different and novel style, characterized especially in respect of diction, by some of the same distinctive features

as are found in Euphuism in England and Chiabrerism in Italy. This later style of Góngora, which his followers and imitators designated the *stilo culto,* is florid, pedantic, full of Latin inversions and mythological allusions, pompous, and mannered, and in many places very obscure. His works were never published during his lifetime. The first edition was printed by his friend, Vicuña, in 1627. See Churton, 'Góngora' (1862).

Goniatites, go"nĭ-a-tī'tēz, a group of ammonites (q.v.), including the earliest forms characterized by the structure of the septa, which are lobed, but without lateral denticulations, as in the higher ammonites; they consequently exhibit, in a section, a continuous undulating line. Some forms with slightly waved septa approach very near to the Nautilus. The siphonal portion is shorter than the sides, forming a sinus at the back, as in the Nautilus. The last chamber, the one tenanted by the animal, occupies a whole whorl, and has besides a considerable lateral expansion. The shells are small, seldom exceeding six inches in diameter. This genus is confined to the Palæozoic strata.

Goniom'eter, a device for measuring the angles of crystals. The application goniometer may be likened to a protractor with a rotary radius. It is a semicircle hinged at 90°, to which are attached two arms of steel which are directly applied to the crystal whose angles are to be measured. Far more accurate is the reflecting goniometer, consisting of a graduated circle mounted either vertically or horizontally upon a stand with an apparatus for adjusting the crystal, and one or two telescopes; it determines through what angular space the crystal must be turned that two rays of light reflected in turn from two surfaces shall have the same direction.

Bonioph'olis, a primitive crocodile of the Jurassic Period. It is distinguished from modern crocodiles by several features, especially by the bi-concave vertebræ and the arrangement of the bony plates on the back. It once inhabited the Jurassic swamps and river-deltas in Europe and America, along with dinosaurs, turtles, etc. A complete skeleton is now exhibited in the Brussels Museum.

Gonorrhœa is perhaps the most universal and widespread of all diseases that affect the human race. Competent authorities have computed that fully three fourths of the adult male population and from one sixth to one third of the adult female population have contracted this disorder. The great majority of women who have gonorrhœa are reputable married women who have been infected by their husbands. Material as well as moral and sanitary conditions modify venereal morbidity. It is much greater in large centres of population than in suburban and rural communities.

Definition.— Gonorrhœa may be defined as a specific inflammation peculiar to certain mucous membranes, attended with the production of a purulent discharge. This discharge has the property of exciting a similar inflammation when brought in contact with other mucous surfaces susceptible to its action. The urethral mucous membrane in the male and the mucous membrane of the urethra, vagina, and cervix in the female are ordinarily the seat of gonorrhœal inflammation. Almost all mucous surfaces of the body, particularly the conjunctival mucous membrane, are susceptible to the irritant action of gonorrhœal pus.

Cause.— The cause of gonorrhœa is a specific micro-organism termed the gonococcus, which was discovered by Neisser in 1879. Inflammation of the urethra may result from a multiplicity of causes, chemical, irritant, and others, but true gonorrhœal inflammation has as its unique etiological factor the gonococcus.

The Gonococcus.— This micro-organism is a diplococcus; in shape each individual of a pair resembles a coffee bean — flat or slightly concave on one side and rounded on the other, with their flat surfaces opposed. The two hemispheres are separated by such a narrow interval that it is only recognizable under a lens of high power. The diplococci are grouped in pairs, fours, and other multiples of two. Their growth occurs by fissure, at right angles to the central interspace. The gonococci are always grouped in irregularly shaped columns, and are never met with in chains or pairs, as certain other micro-organisms. The differential characteristic of the gonococci is, that they quickly take a stain of aniline dyes and are more rapidly bleached than other micro-organisms. They may occur both within and without the pus and epithelial cells. In acute cases they are very numerous, but have a tendency to grow fewer with the decline of the inflammatory process. They are characterized by a marked longevity, are susceptible of existing in a latent state for an indefinite period, and are capable of being revived and exalted in virulence by local irritation which causes congestion of the parts, or when transferred to virgin tissues in which they find conditions favorable for their germination and growth. Numerous cases are on record where the gonococcus has been found still conserving all its virulence, and susceptible of being provoked into new activity by a variety of irritant causes years after infection.

Within the past two or three decades, our knowledge of gonorrhœa has undergone most marked and revolutionary changes. The old conception of gonorrhœa was that of a purely local disease, confined to the mucous tract in which it had its habitual origin, trivial in character, of limited duration, and entailing no serious consequences to the individual, except from neglected complications. The occasional occurrence of rheumatism, or of ophthalmia, which was recognized by the older observers, was thought to be due to the development of a latent rheumatic diathesis, to sympathetic inflammation, or simple metastasis. The idiosyncrasy of the patient was thought to play an important role in their production.

Since the discovery of the gonococcus, new facts have been developed, showing that instead of being limited to the genito-urinary tract, the range of its morbid action is much more extensive, and not infrequently is radiated to important internal organs. As a result of modern investigations, it may be positively affirmed that the gonococcus is susceptible of being taken up by the blood-vessels and lymphatics, and that it may affect almost every organ of the body. Staining and culture experiments have demonstrated its presence not only in the ovaries, tubes, and peritoneal cavity, which it reaches through invasion of the

intermediate mucous membrane, but also in the lining membrane of the brain and cord, of the heart, of the pleura, liver, spleen, kidneys, as well as the joints and tendinous sheaths.

The number, variety, and gravity of these systemic manifestations has led to the serious consideration of the question whether gonorrhœa is not to be classed as a constitutional affection. The cause or relation between these systemic affections and the gonococcus has been proven by the identification of the gonococcus in the lesions it has produced. These general effects have been also ascribed not simply to the pathogenetic action of the gonococci, but to their toxins and the presence of certain pyogenic microbes associated with the gonococcus.

Complications.— The more common complications of gonorrhœa are acute and chronic inflammation of the prostate and bladder and seminal ducts and vesicles, the cord and testes.

Gonorrhœal Arthritis.— One of the most important complications of gonorrhœa is seen in certain joint-affections, which are usually described under the term of gonorrhœal rheumatism. This complication usually occurs from the second to the third week of the disease, but may develop as early as the fifth or sixth day. Gonorrhœal arthritis manifests a remarkable affinity for the large articulations, as the knee and ankle joints, the hip and elbow. Only one joint may be involved, constituting what is termed mono-articular arthritis, or a number of joints may be involved, constituting poly-articular arthritis. In the latter case, different joints are more likely to be involved in succession, rather than simultaneously. As a result of the inflammation of the synovial membrane, which is particularly involved, there often occur serous, fibrinous, or purulent effusions. It is essentially a hydrarthrosis, and in most instances the disease is confined to the synovial membrane of the joint during the whole course of the affection. Gonorrhœal arthritis is usually chronic in duration, often lasting from two to three or for many months. In some cases it is chronic and practically indefinite. Anchylosis or immobility of the joint from rapid formation of adhesions is a not infrequent termination. Very often the tendinous sheaths, the bursæ and fascia may be involved.

Unfortunately the treatment of gonorrhœal rheumatism is extremely unsatisfactory. It does not seem to be susceptible to the curative action of remedies which are valuable in attacks of ordinary rheumatism. In quite a large proportion of cases there is more or less deformity or permanent disability.

Gonorrhœal Ophthalmia.— There is usually recognized a distinction between an ophthalmia which is due to a septic absorption, like gonorrhœal rheumatism, and that form of purulent conjunctivitis which is caused by direct transference of pus containing gonococci to the eye. The former never results from the direct inoculation of the contagious matter. Its symptoms are milder, and there are rarely changes which occasion adhesions or permanent injury to the sight. On the contrary, purulent conjunctivitis is due to the inoculation of the mucous membrane of the conjunctiva. The inflammatory process is characterized by greater intensity and rapidity of action, and not infrequently results in partial or complete loss of vision. Unless prompt and efficient treatment be at once instituted the cornea may rapidly ulcerate and slough, and prolapse of the contents of the globe of the eye may occur through the perforation. These changes are sometimes almost incredibly rapid, taking place in three or four days, exceptionally in 24 hours, and leading to complete destruction of vision. In the ophthalmia of the new-born, the eyes of the child are liable to be soiled with the uterine and vaginal liquids containing gonococci — one of the most frequent causes of blindness. It is estimated that from 10 to 20 per cent of all blindness is caused by gonococcic infection.

Gonorrhœa in Women.— Our knowledge of gonorrhœa in women is essentially a modern acquisition. Until within recent years it had never been the subject of serious and careful study. In the female the local and general effects of gonorrhœa are apt to be much more serious and permanent, owing to the extent and character of the structures exposed to infection. The greater extent of the genital tract permits a larger field for infection by direct continuity of tissue. The periodic vascular changes incident to the menstrual period, and the more pronounced modifications caused by pregnancy, exert a marked influence in accentuating the gravity of gonorrhœa in women. As a result of these changes gonococci, invading the uterine cavity and ascending along the tubes and ovaries to the peritoneal covering, produce peritonitis. Not only do these inflammatory changes imperil the life and health of the woman (which danger, in many instances, can only be averted by an operation involving the sacrifice of her reproductive organs), but they may absolutely extinguish her hope of children. Gonorrhœa is one of the most prolific causes of sterility. The inflammatory changes result in the blocking up of the channels of communication between the ovaries and the uterine receptacle of the ovum, thus preventing contact with the germinative spermatozoids. This mechanical obstacle to the passage of the ovum is, as a rule, permanent and irrelievable. It thus happens that the aptitude of the gonorrhœic woman for conception is often extinguished by the first pregnancy, the first child representing the sum total of her productive energy. In this connection, it may be said that one of the complications of gonorrhœa affecting the male (epididymitis) is a very frequent cause of sterility in men. Neisser believes that gonorrhœa in the male is responsible for 45 per cent of sterile marriages. The proportion of sterility due to the husband is variously estimated from 17 to 25 per cent, and almost the entire proportion of sterility in women is due to gonorrhœa communicated to her by her husband. The low birth-rate of married women is not, as is generally supposed, always voluntary, but it often proceeds from physical causes relating to the health or productive capacity of the married parties; it is not from choice, but from incapacity.

Gonorrhœa as a Social Danger.—Owing to its great frequency, the persistent vitality and virulence of its germs, even after apparent cure, and especially to the grave nature of the infection in women, and the serious menace to the health and even the life of the victim — to say nothing of its destructive effects upon the procreative functions — gonorrhœa is now regarded

by the medical profession as one of the most formidable social plagues of our age. Every year in this country thousands of young, innocent women are infected by their husbands, who in most cases are not aware that they carry with them the germs of a disease destined to wreck the health or lives of their partners. Many such women drag out a miserable existence of semi-invalidism, subject to painful or difficult menstruation, no longer able to walk freely, condemned to pass their days of suffering in a reclining position; and after years, it may be, of this suffering, worn out and desperate, they apply to the surgeon, who, at the price of the sacrifice of their generative organs, renders their existence possible in making them castrated women.

PRINCE A. MORROW, M.D.,
Author 'Relations of Social Disease and Marriage,' New York.

Gonsalvo de Cordova, gōn-säl'vō dė·kŏr'-dō-vä (Sp. gōn-thä'lō dā kŏr'dō-bä), in full GONSALVO HERNANDEZ DE CORDOVA Y AGUILAR, Spanish warrior: b. Montilla, near Cordova, 1453; d. Granada, 2 Dec. 1515. At the court of Ferdinand and Isabella, Gonsalvo attracted much attention by his personal beauty, his knightly skill, and the magnificence of his apparel and style of living. In the war with Granada, 1481–92, he took many places by storm, and vanquished the boldest Moors who dared to meet him in single combat. He was selected to carry on the difficult and dangerous negotiations with the Moorish king Abu Abdallah (or Boabdil), which resulted in the capitulation of Granada and the termination of Moorish rule in Spain. He helped Ferdinand II., king of Naples, to drive the French over the Neapolitan frontiers, and in 1500 delivered Zante and Cephalonia from the Turks and restored them to Venice. In the war between France and Spain, for the sovereignty of Naples, Gonsalvo gained successive victories, until by the fall of Gaëta, the French were forced to yield their claim upon Naples. Ferdinand now bestowed upon him the duchy of Sessa, and appointed him viceroy of Naples, with unlimited powers, which post he held until 1507, when the jealousy of the king caused his removal.

Gontcharoff, gŏn-chä-rŏf, **Ivan Alevander,** Russian novelist: b. Semborsk 18 June 1813; d. St. Petersburg 27 Sept. 1891. He studied at the University of Moscow, obtained a post in the finance ministry in 1835; published his first book, 'A Common Story' in 1837; subsequently was appointed an official in the censor's department, and then, until his retirement in 1873, was editor of the *Northern Post,* a government newspaper. His 'Oblomov' (1858), "a personification of that generic apathy which was, and still is, the common product of the material and moral conditions of Russian life," is his best work. He wrote also 'The Precipice' (1868) and some sketches.

Gon'ville and Caius (kēz) **College,** a college of Cambridge University, England, was founded in 1348 by Edmund Gonville of Terrington, Norfolk, and endowed for a master and three fellows. The original site was between Free School Lane and the churchyard of St. Botolph's. In 1353 William Bateman, bishop of Norwich, Gonville's executor, established the college where the Gonville Court at present stands, and altered the name to the Hall of the Annunciation of Blessed Mary the Virgin. In 1558 Dr. Caius obtained the royal charter by which all the former foundations were confirmed and his own foundation was established. By this charter the college was thenceforth to be called Gonville and Caius College. New statutes were given by which the college is henceforth to consist of a master, 30 fellows, and 36 scholars. The fellowships are all open, and are not vacated by marriage, but terminate generally at the end of 10 years from the full standing of M.A. The scholarships are also open. There are also connected with this college four studentships in medicine, founded by Charles Tancred, and two Harrow scholarships.

Gonzaga, gōn-zä'gä, **Thomaz Antonio Costa de,** Brazilian poet; called the Portuguese Anacreon: b. Oporto, August 1744; d. Mozambique 1809. After studying in the university of Coimbra, Portugal, he returned in 1768 to Brazil to enter on an official career. In 1788 he was about to marry a young lady of distinguished beauty when he became involved in a political conspiracy. The court condemned him to perpetual exile in an island on the coast of eastern Africa, which by special favor was commuted to 10 years' banishment to Mozambique. He left Brazil in 1793, and was attacked by fever soon after reaching Africa, from which he recovered only to fall into madness from the effect of the climate. The most interesting of his poems were composed during his captivity, and celebrate in mournful and tender verse the object of his love under the name of Marilia. They are popular alike in Brazil and Portugal, and have been often reprinted. In grace, tenderness, purity of style, and harmony of verse, Gonzaga ranks among the first Portuguese poets.

Gonzaga Family, a noted Italian family which held the supremacy in Mantua 1328–1707. On 14 Aug. 1328 LUDOVICO (or LUIGI GONZAGA) assumed the sovereignty after his sons had driven out the Bonacorsi family and taken possession of Mantua. He died 1360, aged 93. Among his descendants, GIAN FRANCESCO GONZAGA, in 1432, obtained possession of the city, with its territory, under the title of a marquisate, as a fief from the Emperor Sigismund. With VINCENZO II., the reigning line became extinct in 1627. The next heir would have been the Duke of Nevers, but the Duke of Guastalla, Ferdinand II., one degree more remote, laid claim to the whole inheritance, and Charles Emmanuel, Duke of Savoy, claimed Montferrat. It was evident that the house of Nevers had a legal right, and France, Venice, and the Pope supported him. Spain and Austria, on the other hand, supported the groundless claims of the Duke of Savoy, whence arose a war concerning the Mantuan succession, which ended with the triumph of Charles, Duke of Nevers. His grandson, CHARLES III., succeeded him in 1637, and during his reign the principality obtained full independence. He died in 1665. Many persons of this family have obtained military renown. Others have been conspicuous for their love of the arts and sciences. CÆSAR, in 1565, erected the academy Degl'invaghiti; and others of the family founded galleries of paintings and

antiquities. Giulio Romano, under their patronage, established an extensive school for painting, and many celebrated artists received from them support and honor.

Gonzalez, gōn-sä'lĕs, **Manuel,** Mexican soldier and statesman: b. near Matamoros 18 June 1833; d. Mexico City 8 May 1893. He entered the army in 1839 and fought under Juarez in 1861. In the war against the French he joined Escobedo in 1865 and was made a brigadier-general. Later he joined the party of Diaz and was secretary of war under him 1877–80, and followed him as president of the Mexican republic 1880–4. After his retirement he was governor of Guanajuato.

Goober, or **Gouber.** See PEANUT.

Gooch, SIR **Daniel,** English engineer: b. Bedlington, England, 24 Aug. 1816; d. Clewer Park, England, 15 Oct. 1889. Besides inventing various improvements in the building of locomotives, he was active in furthering the laying of the first transatlantic cable. He sat in Parliament 1865–85, and was connected with the Great Western Railway as a superintendent 1837–64.

Gooch, Frank Austin, American chemist: b. Watertown, Mass., 2 May 1852. He was educated at Harvard and was assistant in the chemical laboratory there, 1872–5. He was subsequently chemist on the Northern Transcontinental Survey and United States Geological Survey, 1878–86, and has been professor of chemistry at Yale from 1886.

Gooch, SIR **William Bart,** English colonial administrator: b. Yarmouth 21 Oct. 1681; d. London 17 Dec. 1751. He was a soldier of Marlborough in the Netherlands, and was governor of Virginia from 1727 to 1747. In 1740 he accompanied Vernon's expedition against Cartagena, and in 1749, after a generally excellent and successful administration, returned to England. During his term of office he opposed religious toleration to religious organizations other than the Establishment.

Good, James Isaac, American (German) Reformed clergyman: b. York, Pa., 31 Dec. 1850. He was graduated from Lafayette College, Easton, Pa., in 1872; entered the Reformed ministry and has been successively pastor of Heidelberg Reformed Church, York, Pa., 1875–7; Heidelberg Reformed Church, Philadelphia, 1877–90; and Calvary Reformed Church, Reading, Pa., 1890–3. Since the last named year he has been professor of dogmatics at Ursinus College. He has published: 'Origin of the Reformed Church of Germany' (1887); 'Rambles Round Reformed Lands' (1889); 'History of the Reformed Church in the United States.'

Good, John Mason, English physician and author: b. Epping, Essex, 25 May 1764; d. Shepperton, Middlesex, 2 Jan. 1827. In 1793 he removed to London, where he carried on business for several years as a surgeon and apothecary, and after 1820 practised as a physician. His principal works are: 'Memoirs of the Life and Writings of Dr. Alexander Geddes' (1803); Translations of Solomon's Song and the Book of Job; a translation of Lucretius 'On the Nature of Things' (1805); 'Medical Technology' (1810); 'A Physiological System of Nosology' (1817); 'The Study of Medicine' (1822); and 'The Book of Nature' (1826).

Good Friday, the name applied by the Church of England to the Friday before Easter, sacred as commemorating the crucifixion of our Lord; the Great and Holy Parasceve is the Greek title of it, and it is called in the Roman Missal the Parasceve. This day was kept as a day of mourning, of rigid fast, and of special prayer from a very early period. Eusebius (260 A.D.) says that the day had been observed long before his time. Constantine ordered a cessation from all labor on that day. It was one of the two paschal days celebrated by the Christian Church, and in memory of the crucifixion was called by the Greeks Pascha Staurosimon or the "Pasch of the Cross." In the Roman Catholic Church the service of this day consists of what is called the Mass of the Presanctified, the sacred host not being consecrated on Good Friday, but reserved from the preceding day. Communion is forbidden on Good Friday, except in the case of the celebrant and of sick persons.

The most striking part of the ceremonial is the so-called "adoration of the cross," or, as it was called in the Old English popular vocabulary, "creeping to the cross." The black covering is removed from a large crucifix which is placed before the altar, and the entire congregation, commencing with the celebrant priest and his ministers, approach, and on their knees reverently kiss the figure of our crucified Lord. The very striking office of *Tenebræ* (darkness) is held on Good Friday, as well as on the preceding two days: it consists of the matins and lauds of the following day, and has this peculiarity, that by the close all the lights in the church have been gradually extinguished except one, which for a time (as a symbol of our Lord's death and burial) is hidden at the Epistle corner of the altar.

In the Church of England, and in the Protestant Episcopal Church of the United States, as well as in the Roman Catholic Church, Good Friday is celebrated with special solemnity: proper psalms are appointed, and one of the three special collects is a prayer for "all Jews, Turks, infidels, and heretics." In some churches of the English Church, and of the Protestant Episcopal Church, the *improperia,* or reproaches, adopted from the Roman service, are sung; and Bach's passion music is frequently heard. In England and Ireland Good Friday is by law a *dies non,* and all business is suspended; but this is not the case in Scotland or the United States. In Scotland the day till recently met with no peculiar attention, except from members of the Episcopal and Roman Catholic communions; but of late years there have been services in some Presbyterian churches in the larger towns.

A German savant, Prof. Hans Achelis of Königsberg, has decided on the basis of exact calculations made by the Royal Astronomical Society of Berlin that the date of the Crucifixion was 6 April 30 A.D.

Good Hope, Cape of. See CAPE OF GOOD HOPE.

Good Templars, a temperance society which combines the principles of teetotalism with certain mystic rites, imitated less or more from freemasonry, having secret signs, pass-

words, and insignia peculiar to itself. It originated in Utica, N. Y., where it was organized by Daniel Cady and others, in 1851, and extended to England in 1868. There is no restriction placed on membership on account of color, age, or sex. The organization consists of local "subordinate" lodges, county "district" lodges, national "grand" lodges, and an international "right worthy" grand lodge. A "juvenile order" is also attached, and the Templars have founded an orphanage at Sunbury, near London, at a cost of $50,000. It has no beneficiary system. Its platform consists of total abstinence from all intoxicating liquors as a beverage, no license, but prohibition of manufacture and sale, and the election of men who will enforce the liquor laws. The motto of the order is "Faith, Hope, and Charity." It is an outgrowth of the Sons of Temperance.

Good-will, the benefit derived from a business beyond the mere value of the capital, stock, funds, or property employed in it, in consequence of the general public patronage and encouragement which it receives from constant and habitual customers. It is legally considered a subject of sale along with the stock, premises, fixtures, trade debts, etc. It is usual for the seller to enter into an express covenant not to carry on a business of the same kind at some specified moderate distance from the place where the purchaser resides, and if he breaks the covenant he is liable to an action for damages. In most of the States of the Union the purchaser of good-will can only cut the seller off from soliciting old customers of the business surrendered and from otherwise attempting to supplant the new tenant in popular favor, by securing a written contract.

Good'ale, Dora Read, American poet: b. Mount Washington, Berkshire County, Mass., 29 Oct. 1866. With her older sister, Elaine Goodale (q.v.), she began to write verse in early childhood. Her poems, and those of her sister, appeared in magazines at that time and attracted much favorable notice. With her sister she published: 'Apple Blossoms' (1878); 'In Berkshire with the Wild Flowers' (1879); 'All Round the Year' (1880). She has also published 'Heralds of Easter' (1887).

Goodale, Elaine (Mrs. Eastman), American poet: b. Mount Washington, Mass., 9 Oct. 1863. In June 1891, she was married to Charles A. Eastman, M.D., an educated Sioux Indian. At an early age she began to write verse and with her sister Dora (q.v.) published: 'Apple Blossoms: Verses of Two Children' (1878); 'In Berkshire with the Wild Flowers' (1879); 'Verses From Sky Farm' (1880). She was sole author of 'Journal of a Farmer's Daughter' (1881). She taught for some time in the Hampton Institute in Virginia, and edited the 'Southern Workman' (1883). In 1885 she visited the Great Sioux reservation, and subsequently taught school at White River Camp, Lower Brulé Agency, Dakota.

Goodale, George Lincoln, American botanist: b. Saco, Me., 3 Aug. 1839. He was graduated from Amherst College in 1860 and has been instructor and professor of botany at Harvard from 1872. He has published: 'Concerning a Few Common Plants' (1879); 'Physiological Botany' (1885); 'Wild Flowers of America' (1886); 'Useful Plants of the Future.'

Good'all, Edward, English line-engraver: b. Leeds 17 Sept. 1795; d. London 11 April 1870. He was self-taught, and early in his career attracted the notice of Turner, a number of whose pictures he engraved. He also engraved many plates for the annuals.

Goodall, Frederick, English painter: son of Edward Goodall (q.v.): b. London 17 Sept. 1822; d. London 29 July 1904. At 17 years of age he began to exhibit, and he has produced some pictures of high excellence. He was elected to the Royal Academy in 1863. Among important works of his are: 'Raising the Maypole in the Olden Time' (1851); 'Cranmer at the Traitors' Gate' (1856); 'The Subsiding of the Nile' (1873); 'Andromeda' (1887); 'The Thames from Windsor Castle' (1890); 'Isles of Loch Lomond' (1891); 'The Palm Grove' (1894).

Goode, George Brown, American naturalist: b. New Albany, Ind., 13 Feb. 1851; d. Washington, D. C., 6 Sept. 1896. He was graduated from Wesleyan University in 1870, and from 1887 was assistant secretary of the Smithsonian Institution. Among his publications are: 'Museums of the Future' (1890); 'American Fishes'; 'Nature and Economic History of the American Menhaden.'

Goode, Richard Urquhart, American geographer: b. Bedford, Va., 8 Dec. 1858. He studied at the University of Virginia, was topographer to the United States Geological Survey in 1879–82, engineer and topographer of the Northern Transcontinental Survey in 1882–4, and in 1889 was appointed geographer of the United States Geological Survey. His writings include reports and articles in periodicals.

Goode, William Athelstane Murray, American newspaper correspondent: b. Newfoundland 10 June 1875. After service in the British merchant marine and the United States cavalry, he became assistant night city editor of the New York *Recorder,* later city editor of the *Mercury,* and finally correspondent of the Associated Press, of which he was representative on board the flagship New York during the Spanish-American war. He contributed to magazines and published 'With Sampson Through the War' (1899).

Goodell', Henry Hill, American educator: b. Constantinople, Turkey, 20 May 1839; d. at sea 23 April 1905. He was graduated from Amherst College in 1862; was in the Union army in 1862–3; professor in the Massachusetts Agricultural State College in 1867–86, and in 1886 became its president. For several years he was chairman of the Executive Committee of the Association of American Agricultural Colleges and experiment stations, and in that capacity did much to further the interests of agricultural education.

Goodell, William, American missionary: b. Templeton, Mass., 14 Feb. 1792; d. Philadelphia 18 Feb. 1867. He was graduated from Dartmouth College in 1817, and from the Andover Theological Seminary in 1820; was ordained to the Congregational ministry in 1822, and in the same year went to Syria as a mis-

sionary. In 1823 he assisted in the establishment of the mission-station at Beirut, in 1823–8 was active there, in 1828–31 at Malta, in 1831–65 at Constantinople. Among his most important works was the preparation of a translation of the Bible into Armeno-Turkish.

Goodell, William, American abolitionist: b. Coventry, N. Y., 1792; d. 1878. He was in business at different times in Providence, Alexandria, Va., and New York; in 1827 began at Providence the publication of the *Investigator*, and later was editor of a series of abolition periodicals, including the 'Friend of Man,' official mouthpiece of the New York Anti-slavery Society; the 'Radical Abolitionist,' and the 'Principia.' His published volumes include: 'The Democracy of Christianity' (1851); 'Slavery and Anti-slavery' (1852); 'The American Slave Code' (1853).

Goodknight, James Lincoln, American educator: b. Allen County, Ky., 24 Aug. 1846. He was graduated from Cumberland University (Lebanon, Tenn.) in 1871, from the Union Theological Seminary in 1879, studied also at Edinburgh and Jena, and was president of West Virginia University (Morgantown). In 1900 he became president of Lincoln (Ill.) University. His articles have appeared in various periodicals.

Good'land, Kansas, county-seat of Sherman County; on the Chicago, R. I. & P. R.R. The manufactures are flour and machinery. The city contains railroad repair-shops and grain elevators, and is the centre of trade for a large agricultural region in which there are a number of cattle ranches. Pop. (1900) 1,059.

Good'man, Edward John, English journalist and novelist: b. London 19 Dec. 1836. He entered journalism in 1857 and has served on the editorial staffs of several prominent English journals, including the London *Daily Telegraph*. Besides 'The Best Tour in Norway' (1891); 'Wilson's Handbook to Norway' (1894); and 'New Ground in Norway' (1896), he is the author of the novels 'Too Curious' (1887); 'Paid in His Own Coin' (1888); 'His Other Self' (1889); 'The Only Witness' (1891); 'The Fate of Herbert Wayne' (1892); 'The Night of the Fog' (1895).

Good'now, Frank Johnson, American legal scholar: b. Brooklyn, N. Y., 18 Jan. 1859. He was graduated from Amherst College in 1879, from the Columbia Law School in 1882, studied also at the Paris Ecole Libre des Sciences Politiques and Berlin University, and was appointed to the chair of administrative law at Columbia in 1883. A recognized authority on municipal, administrative, and constitutional law, he published: 'Municipal Home Rule' (1890); 'Comparative Administrative Law' (1893), 'Municipal Problems' (1897); 'Politics and Administration' (1900).

Good'rich, Alfred John, American writer on musical subjects: b. Chilo, Ohio, 1847. Largely self-taught, he was professor of musical theory in several institutions, and from 1899 directed his attention wholly to writing and private instruction. 'Music as a Language' (1880); 'Complete Musical Analysis' (1889); and 'Analytical Harmony' (1894) are among his books.

Goodrich, Charles Augustus, American Congregational clergyman: b. Ridgefield, Conn., 1790; d. Hartford, Conn., 4 Jan. 1862. He was graduated at Yale in 1812 and held pastorates of Congregational churches in Worcester, Mass., 1816–20, Berlin, Conn., 1820–48, and Hartford, Conn., from 1848. He published: 'Lives of the Singers' (1829); 'History of the United States' (1852–55); 'Universal Traveler,' etc. He was a brother of S. G. Goodrich (q.v.).

Goodrich, Chauncey Allen, American clergyman and lexicographer: b. New Haven, Conn., 23 Oct. 1790; d. there 25 Feb. 1860. He was graduated at Yale College in 1810, and was tutor there 1812–14. After a course of theological study he entered the ministry and was pastor of a Congregational church in Middletown, Conn., 1816–17; was elected professor of rhetoric and oratory in Yale 1817–39, and became professor of pastoral theology in the theological department of the college in 1839. While tutor he published in 1814 a Greek grammar, translated chiefly from the grammar of Hachenberg. This he subsequently revised and enlarged, and published under his own name. It was often reprinted, and for many years was extensively used. About 1832 he published 'Latin Lessons' and 'Greek Lessons,' in which the precepts of grammar are throughout accompanied by practical exercises — a method subsequently applied by Ollendorff to modern languages. In 1828 Noah Webster (his father-in-law) entrusted to him the superintendence of the octavo abridgment of his large dictionary, by J. E. Worcester, with discretionary power to conform the orthography more nearly to the common standard. After several years of labor, he published in 1847 greatly enlarged and improved editions of the 4to and 8vo dictionaries of Dr. Webster. In 1856 he published in 8vo the university edition of Webster's dictionary, and in 1859 a new issue of the unabridged 4to dictionary.

Goodrich, Frank Boot («Dick Tinto»), American writer: b. Boston, Mass., 14 Dec. 1826; d. Morristown, N. J., 1894. He first became known by his Paris letters to the New York *Times*. He was the author of: 'Court of Napoleon: or, Society Under the First Empire' (1857); 'Women of Beauty and Heroism' (1859); 'World-Famous Women, from Semiramis to Eugénie' (1870); etc.

Goodrich, Samuel Griswold («Peter Parley»), American writer: b. Ridgefield, Conn., 19 Aug. 1793; d. New York, 9 May 1860. He began as a publisher in Hartford, and established himself in 1824 as a publisher in Boston. He edited there, from 1828 to 1842, 'The Token,' an annual to which he contributed several tales and poems, and in which also appeared some of Hawthorne's 'Twice-Told Tales.' His famous Peter Parley series of popular and juvenile books was begun soon after his removal to Boston, and gradually extended to more than 116 volumes, comprising geographies, histories, travels, stories, and various illustrations of the arts and sciences. The geniality of these, and the admirable manner in which the author enlisted the sympathies of children, procured for them an immense success, which led to the issue in England of some spurious books under the name of «Peter Parley.» In 1837 he published a collection entitled 'The Outcast, and

Other Poems'; and in 1838 an ethical and educational work entitled 'Fireside Education.' In 1841 appeared a selection from his various contributions to annuals and magazines under the name of 'Sketches from a Student's Window'; and in 1857 'Recollections of a Lifetime,' a most entertaining account of his own history and that of his contemporaries. 'Merry's Museum' and 'Parley's Magazine' were conducted by him from 1841 to 1854. Under Fillmore's presidency he acted as American consul at Paris, and published there in French a treatise on 'American Geography and History.' The last work from his pen was the 'Illustrated Natural History of the Animal Kingdom' (1859).

Good'sell, Daniel Ayres, American Methodist bishop: b. Newburg, N. Y., 5 Nov. 1840. Graduated from New York University (then the University of the City of New York) in 1859; he entered the Methodist ministry in the same year; in 1880–8 was literary editor of the 'Christian Advocate' of New York, and in 1888 was elected bishop and became secretary of the Methodist board of education. He wrote 'Nature and Character at Granite Bay' (1901).

Goodwin, J. Cheever, American dramatist: b. Boston 14 July 1850. He was graduated from Harvard in 1873, was a reporter on the Boston *Traveller* in 1873–4, and secretary to the comptroller of New York in 1886–91. His writings include verse in periodicals and many plays, among them some popular successes, such as 'Evangeline,' 'The Panjandrum,' 'Wang,' 'The Lion Tamer,' 'Lost, Strayed, or Stolen,' and 'The Monks of Malabar.'

Goodwin, Maud Wilder, American historical novelist: b. 1856. She has published: 'The Colonial Cavalier'; 'The Head of a Hundred'; 'White Aprons: An Historical Romance'; 'Dolly Madison,' a biography; 'Historic New York' (1898); 'Sir Christopher'; 'Flint'; etc.

Goodwin, Nathaniel Carl, American actor: b. Boston 1857. His first appearance was made in 'Law in New York,' at the Howard Athenæum, Boston, and subsequently he became known in burlesque and light comedy. Among the dramas which he has since presented are: 'A Gilded Fool'; 'In Mizzoura'; 'An American Citizen'; his chief success, 'Nathan Hale'; and 'The Altar of Friendship.' He also essayed «Shylock» in Shakespeare's 'Merchant of Venice.'

Goodwin, William Watson, American Greek scholar: b. Concord, Mass., 9 May 1831. He was graduated at Harvard College in 1851; and was Eliot professor of Greek there 1860–1901. He published: 'Syntax of the Moods and Tenses of the Greek Verb'; 'Greek Grammar'; and a revised translation of 'Plutarch's Morals' (1871).

Good'y, a local name in the Southern States for a small bay fish (*Leiostomus xanthurus*), much liked as a pan-fish, and known also as «lafayette» and about New York as «spot.» It is one of the family *Sciænidæ* (see DRUM-FISH), has a deep, compressed body, bluish above and silvery below, with «about 15 narrow, dark, wavy bands extending from the dorsal downward and forward to below lateral line; a round black humeral spot rather smaller than the eye.» It abounds from Cape Cod to Texas.

Good'year, Charles, American inventor: b. New Haven, Conn., 29 Dec. 1800; d. New York 1 July 1860. After coming of age, he joined his father in the hardware business at Philadelphia. Among the improved implements introduced by them was the steel pitchfork, a substitute for the heavy iron fork previously used. The firm being overwhelmed by the commercial disasters of 1830, Goodyear selected as a new occupation the improvement of the manufacture of India rubber. The first important improvement made by him was at New York in 1836, being a method of treating the surface of native India rubber by dipping it into a preparation of nitric acid. This discovery enabled the manufacturer to expose an India rubber surface in his goods, which on account of adhesiveness was before impracticable. The nitric acid gas process, as it was called, was introduced into public use, and met with great favor, especially in the manufacture of shoes, which continued to be made by that process in great numbers at Providence, R. I., until it was superseded by the invention of vulcanized rubber, for which he obtained a patent in 1844. From this period he employed himself in ascertaining new methods of employing rubber till the patents granted him were 60 in number. He received medals from the Exhibitions at London (1851) and Paris (1855), but his rights were continually infringed, and he remained poor while others were enriched by his inventions.

Goodyear, William Henry, American writer on art: b. New Haven, Conn., 21 April 1846. He was appointed curator of the New York Metropolitan Museum of Art in 1881. He has published: 'Ancient and Modern History' (1883); 'History of Art' (1887); 'The Grammar of the Lotus' (1890); 'Roman and Mediæval Art' (1893); 'Renaissance and Modern Art' (1894); etc.

Goo'kin, Daniel, American author and official: b. Kent, England, about 1612; d. Cambridge, Mass., 19 March 1687. He came with his father to Virginia in 1621, whence he removed in 1644 to Massachusetts, in consequence of his sympathy with the doctrines of the Puritans. He settled in Cambridge, was soon after appointed a captain of militia, and in 1656 became superintendent of all the Indians who had submitted to the government of Massachusetts, an office which he held till his death. He protected the fugitive regicides in 1661, was appointed one of the two licensers of the Cambridge printing press in the following year, became unpopular during King Philip's war by the protection which, as a magistrate, he extended to the Indians, and in 1681 was made major-general of the colony. His 'Historical Collections of the Indians of Massachusetts' bears the date of 1674, and was first published by the Massachusetts Historical Society in 1792. He is said to have written also a history of New England, of which no manuscript has been found.

Goorkhas, goor'kaz. See GHURKAS.

Goosan'der. See MERGANSER.

Goose. See GEESE.

Goose-barnacle. See BARNACLE; BERNACLE-GOOSE.

Goose-fish, or Angler, a marine fish (*Lophius piscatorius*) of the order *Pediculati,* with an enormous head and mouth, no scales, and brightly colored fringes about the jaws, which serve as lures to attract within reach the small fishes on which it preys; the first three rays of the dorsal fin are separated from the others, and spring barbel-like from the top of the head, nodding in the water and attracting other small fishes,— hence the name "angler." Like all fishes of its order, the carpal bones are elongated to strengthen and widen the reach of the pectoral fins, by means of which the fish leaps after its prey. The angler is popularly supposed to catch geese and other swimming birds, whence its name. It reaches a length of four feet, but is useless, and the bane of fishermen. It is remarkable for its pinkish ribbon-like masses of eggs, a foot wide, 40 feet in length, which are not uncommon in summer floating at the surface of the ocean. The goose-fish occurs on both coasts of the North Atlantic and has other names, as "fishing-frog," and "all-mouth." Near relatives are the batfish and the frog-fishes.

Goose-grass, or Gosling-weed, two of the many names applied to a widely distributed troublesome weed (*Gallium aparine*). See BEDSTRAW; CLEAVERS.

Gooseberry, goos'- or gooz'bĕr-ĭ, various spiny shrubs of the genus *Ribes,* natural order *Saxifragaceæ* or *Grossulariaceæ,* mostly natives of the northern hemisphere, especially of North America; some species valued for their fruit (berries), others for their flowers. Of the half dozen species cultivated, the European gooseberry (*R. grossularia*), which appeared in gardens during the 16th century, has developed the largest number of varieties and attracted the widest interest. Its progeny furnish practically all the varieties exhibited at the annual gooseberry shows of England. The fruits of some of these varieties weigh more than an ounce, having been developed by selection and crossing from an original weight of about one quarter of an ounce. The varieties may be divided, like apples or pears, into culinary and dessert sorts. They have not proved generally successful in America, the climate being considered too dry for them. Of the American species, several of which bear finer fruits than the natural European species, *R. oxyacanthoides* is the only one that has produced widely cultivated varieties. It has also entered into many hybrids with the European species. These American varieties are all of the culinary class, or are used while too unripe to be palatable as dessert. The first one, Houghton, was introduced about 1835, and with its seedling, Bowning, still commands the market. In America attention has not been attracted to the gooseberry because the American people have not cultivated a taste for dessert gooseberries. Of the ornamental species, *R. speciosum* is cultivated for its nearly evergreen shining foliage and its fuchsia-like showy flowers. It is not hardy in the northern United States.

The gooseberry is one of the easiest fruits to propagate. Cuttings of mature wood are most frequently used, but layers and suckers are also employed. The plants thrive best upon rather heavy, moist soil, and generally fail upon light soils, especially if dry. They like partial shade and northern exposures. In the South they fail. The plants may be transplanted in spring or fall, about 5 feet apart each way, cultivated frequently until mid-summer, trained and pruned like the currant (q.v.), but somewhat more openly, kept free from fungous troubles by the use of a fungicide (q.v.) and of insects by the use of an insecticide (q.v.). The fungi most frequently found upon the plants are mildew (*Sphærotheca mors-uvæ*) and leaf spot (*Septoria ribis*). The former, which is a surface feeder, appears upon the green parts as a frost-like gray growth, which later becomes brown. Free circulation of air, good drainage and open training of the bushes helps to prevent attacks. Leaf spot produces brown spots upon the foliage, which may fall prematurely. Spraying early in the season is believed to be the only preventive. With few exceptions, the insects that attack the gooseberry also visit the currant (q.v.) and may be combated by the same remedies. Consult: Card, 'Bush Fruits' (New York 1898); Thory, 'Monographie ou Histoire Naturelle du Genre Grosseillier'; Bailey, 'Cyclopædia of American Horticulture' (1900–2).

Gooseberry Insects. See CURRANT-INSECTS.

Goosefoot, a family (*Chenopodiaceæ*) of annual or perennial herbs, rarely shrubs, with 75 to 80 genera and 550 to 600 species, of wide distribution. The typical genus (*Chenopodium*) contains about 60 species, 15 or 20 of which are native to North America, or have been naturalized, some of them almost ubiquitous weeds, such as the pigweed (*C. album*); the city goosefoot (*C. urbicum*), thriving in suburban lots and roadways; the sowbane (*C. murale*); the turnpike or feather-geranium or Jerusalem oak (*C. botrys*); the now world-wide Mexican tea (*C. ambrosiodes*); and the wormseed (*C. anthelminticum*), from which is brewed a home-made vermifuge. Other genera contain allied weeds, as the strawberry blite (*Blitum capitatum*); the large genus (*Atriplex*) of sea-side and salt-land weeds called oraches; the western white sage (*Eurotia lanata*), a gray-green, pubescent fodder plant of the western plains; the sea-blites (*Dondia*) and odd brittle glass-worts of salt marshes; and the spiny grease-wood and Russian thistle (qq.v.). See CHENOPODIUM.

Go'pher, a name given by the early French settlers in the United States to various animals which honeycomb (Fr. *gaufre*) the ground by burrowing in it. In the Central States the name refers to the too common "striped" gopher, or ground-squirrel (*Spermophilus tridecemlineatus*), a troublesome little animal about 10 inches long, a third of which is tail, which is dark-reddish brown, with 6 to 8 light stripes, alternating with lines of dots — about 13 in all: it is yellowish below, with a broad black stripe on each side. It is a familiar object on prairies and grassy fields throughout the upper half of the Mississippi valley, hurrying to and from its hole, or standing upright, but inconspicuous, curiously watching your movements, but ready to drop out of sight at the least alarm. The burrows are numerous everywhere, and are injurious not only by the space they occupy, and as traps for the feet of horses and cattle, but because they offer run-

ways for water and so promote washing away of soil. Some of the holes are short, and are merely shelters; others are long, have a nest at the inner extremity, and side-chambers in which in the autumn large winter stores of seeds are laid away. Where these spermophiles are very numerous, as they have become in the grain-growing districts, of Iowa, Minnesota and the Dakotas, the amount of grain stolen or shaken down is a serious tax on agriculture. Another spermophile, more common northward, is Franklin's or the "gray" gopher (*S. franklini*), which is much larger and has a harsh coat of yellowish-grizzled hair. Several other species inhabit the more western plains. All are truly ground-squirrels of the family *Sciuridæ,* and closely related to the chipmunk (q.v.).

In the farther Northwest, however, the word "gopher" ordinarily means one of the large gray rodents of the family *Geomyidæ,* distinguished prominently by having in the cheeks capacious pouches, lined with fur; hence they are called pocket-gophers and pouched rats. The most familiar species is *Geomys bursarius,* which is about nine inches long and has short legs, close ears and a short hairy tail; the fore feet are very strong, with the three middle toe-nails long and well-adapted to digging, and its burrows are made with surprising rapidity. Its food includes all sorts of vegetable matters, and it often injures orchards by gnawing the roots. As fall approaches it gathers a store of seeds, tuberous roots, nuts, etc., and stows it in its deep residence-burrow, where the winter is passed in a partial torpidity varying with the climate. These provisions are carried in the cheek-pouches, which also serve to take out the loose soil from the burrows. On the Pacific coast occur several other species, some with large, pendent cheek-pouches. In the Southern States is found a species (*G. tuza*), locally called "Salamander," of large size and common in the sandy parts of Florida and the country north of it. The Northwest has a second and smaller kind of gopher (*Thomomys talpoides*), dusky bluish-gray in color, with the lower parts whitish, which is mole-like in its habits, and is known in Idaho as "camass-rat," on account of its fondness for the tubers of the liliaceous plant called camass (*Camassia esculenta*) by the Indians.

All of these animals are a pest to agriculture, and are increasing rather than diminishing in settled regions, owing partly to the increased food afforded them by crops, and partly to the destruction of their natural enemies, the birds of prey, snakes, weasels, foxes, badgers, wolves, etc., which formerly held them in check. Efforts are therefore made to exterminate them in various ways, of which the most effective is by suffocating them with bisulphide of carbon, placed in their holes by saturating some porous object and rolling it into the burrow. Several pamphlets issued by the United States Department of Agriculture describe the animals and their habits, and give directions for their suppression.

Gopher Snake, or **Indigo Snake,** a variety of a tropical colubrine snake (*Compsosoma corais*) common in the southwestern United States and eastward to Georgia, which reaches a length of 10 feet, and is brownish black with reddish markings about the mouth and throat. It burrows beneath loose soil, is harmless to man, and is believed to prey upon rattlesnakes at every opportunity.

Gopher State, a name sometimes given to Minnesota.

Gopher Tortoise or **Turtle,** a burrowing turtle (*Xerobates polyphemus*) of the southern United States, brownish in color with black head; yellowish below. It is herbivorous and gregarious, and is most frequently found in the pine barrens, where it is frequently eaten by the negroes, who are also fond of its eggs.

Go'ral, a goat-like antelope (*Nemorrhædus goral*) from the Himalaya Mountains. It resembles somewhat the chamois, and remains in small bands on the highest parts of the mountains. Other species or varieties inhabit the high plateaus of Tibet and Mongolia.

Goramy, gō'ra-mĭ, or **Gourami,** goo'ra-mĭ, the Javanese name of a fish of the genus *Osphromenus* (*O. olfax*), family *Anabasidæ* or climbing perches, a native of China and the Eastern Archipelago, but introduced into the Mauritius, West India Islands, and Cayenne on account of the excellence of its flesh, where it has multiplied rapidly. It is deep in proportion to its length, and the dorsal and anal fins have numerous short spines, while the first ray of the ventral is protracted into a filament of extraordinary length. It is one of the few fishes which build nests, which it does by interweaving the stems and leaves of aquatic plants.

Gordiacea, gôr-dĭ-ā'sē-a, an order of *Nematohelminthes,* the hair-worms (q.v.).

Gordian Knot, a knot tied by Gordius in the rope which bound the yoke of his chariot to the axle-tree in such an artful manner that the ends of the cord could not be perceived. The Phrygians had learned by an oracle that a king would come to them riding in a car, and Gordius appearing thus at an opportune time, received the kingdom. He dedicated his car and yoke of oxen to Zeus, with the knot still untied. So intricate was it that the report went abroad that the empire of Asia was promised by the oracle to him who could untie it. Alexander the Great, wishing to inspire his soldiers with courage and his enemies with the belief that he was born to conquer Asia, cut the knot with his sword, and so claimed to have fulfilled the oracle. Hence to "cut the Gordian knot" is equivalent to removing or solving a difficulty by bold or unusual measures.

Gordia'nus, Marcus Antonius, the name of three Roman emperors, father, son, and grandson. The first, b. 158 A.D., had governed Africa for many years, when he was proclaimed emperor at the age of 80. He associated his son with him in the empire, but six weeks later the son was killed in fighting against the rival emperor Maximinus, and the father, in an agony of grief, died by his own hand. The grandson was proclaimed emperor by the soldiers in Rome 238 A.D., although not more than 15. He reigned six years, when he was assassinated by his soldiers at the instigation of Philip, prefect of the Prætorian guard.

Gordon, Archibald D., American dramatist: b. Ceylon 11 Oct. 1848; d. Port Richmond, Staten Island, N. Y., 9 Jan. 1895. He was dramatic critic for several New York and Chi-

cago journals, and published: 'Trixie'; 'The Ugly Duckling'; 'Is Marriage a Failure?'; 'That Girl from Mexico.'

Gordon, Charles George («CHINESE GORDON» or «GORDON PASHA»), English soldier: b. Woolwich 28 Jan. 1833; d. Khartum, Africa, 27 Jan. 1885. He entered the Royal Engineers as second lieutenant in 1852, and served in the Crimean war and during the Taiping rebellion, with the permission of the English military authorities, assumed the command of a special corps of Chinese, trained and led by European and American officers. With these materials he performed marvelous feats of skilful soldiership and succeeded in completely crushing the rebellion. The Chinese government was eager to express its gratitude, but he refused all offers of substantial reward. On his return to England with the rank of colonel, he was appointed chief engineer officer at Gravesend for the construction of the Thames defenses. Here, while his engineering work afforded ample scope for his military talents, the philanthropy of his nature had full scope. During the six years he lived at Gravesend his house was school, and hospital, and almshouse in turn. Many a waif he rescued from the gutter, establishing evening classes for their benefit, and keeping sight of the more deserving till they were provided with a career in life; all this being done on his pay as an English colonel, without any private resources whatever. In 1873, on the resignation by Sir Samuel Baker of his command, Gordon was appointed in his place, under the khedive of Egypt, and from 1874 until 1879 governed the vast region of the Sudan with credit to himself and with satisfaction to the Cairo administration. In 1881 Mohammed Ahmed, a Mussulman enthusiast, gave himself out to be the Mahdi — the long-expected Redeemer of Islam — and gathered a number of followers around him who threatened the safety of the Egyptian garrisons in the Sudan. It having been decided that the Sudan be evacuated, the presence of an English officer of high authority at Khartum was asked, with full power to withdraw all the garrisons in the Sudan, and make the best arrangements possible for the future government of the country. Gordon, at the request of the British government, proceeded to the Sudan in the hope that his great personal influence and knowledge of the country would help to set matters right. These hopes were not fulfilled; Gordon was shut up in Khartum by the troops of the Mahdi, and for a whole year he held that town against the Arabs who surrounded him. An English force under Wolseley was despatched for his relief, an advance corps of which sighted Khartum on 28 Jan. 1885, to find that the town had been treacherously betrayed into the hands of the Mahdi two days before, and that its heroic defender had been killed. Gordon had all the qualities which are found in a successful military leader, modified, however, by the strong religious feeling which tinged his mind from an early period, and which latterly became so intensified as to give him somewhat the character of a religious enthusiast and fatalist. He left a most interesting journal, kept during the latter period of his siege in Khartum. Consult: Hill, 'Gordon in Central Africa' (1881); Lives by Forbes (1884); Henry Gordon (1886); Boulger (1896).

Gordon, Charles William («RALPH CONNOR»), Canadian author: b. Indian Lands, Glengarry, Ont., Canada, 1860. He was graduated at Toronto University in 1883 and at Knox College in 1887; was ordained to the Presbyterian ministry and was a missionary in the mining and lumbering regions of the Rocky Mountains 1890–4. He became pastor of St. Stephen's Church of Winnipeg in 1894, and wrote: 'Beyond the Marshes'; 'Black Rock'; 'Gwen's Canon'; 'The Sky Pilot'; 'Ould Michael'; 'The Man from Glengarry'; 'Glengarry School Days'; and 'The Prospector' (1904), works characterized by vivid descriptions of life and scenery in the Canadian West.

Gordon, LORD George, English agitator: b. London 26 Dec. 1751; d. there 1 Nov. 1793. He was a son of the Duke of Gordon, and entered Parliament in 1774. In 1778, a bill having been passed through Parliament for the relief of Roman Catholics from certain penalties and disabilities, a society called the Protestant Association of London was formed for the purpose of procuring its repeal. In the following year Lord George was elected its president, and in June 1780 headed an excited mob of about 100,000 persons, who went in procession to the House of Commons to present a petition against the measure. The dreadful riot which ensued, and which was not suppressed till after the destruction of many Catholic chapels and dwellings, the prison of Newgate, and the house of the chief justice, Lord Mansfield, led to the arrest of Lord George Gordon, and his trial on the charge of high treason; but no evidence being adduced of treasonable design, he was acquitted. He died, after having become a zealous professor of the Jewish faith.

Gordon, George Henry, American soldier: b. Charlestown, Mass., 19 July 1824; d. Framingham, Mass., 30 Aug. 1886. Graduated from West Point in 1846, he was employed on various duty, later resigned from the army, and practised law 1857–61. In 1861 he organized the Second Massachusetts Volunteers, and became colonel of the regiment. He commanded the United States troops in Florida in 1864, the eastern district of Virginia in 1865, and was mustered out in the latter year with rank of brigadier-general and brevet major-general of volunteers. He wrote a 'History of the Second Massachusetts Regiment' (1876), and other works on the war.

Gordon, John Brown, American soldier: b. Upson County, Ga., 6 July 1832; d. near Miami, Fla., 9 Jan. 1904. He was of Scotch ancestry, his grandfather being one of seven brothers who all fought for American independence in the War of the Revolution. He was graduated at the State University in 1852 and was, a few months later, admitted to the practice of law; but at the outbreak of the Civil War was engaged in mining operations near Raccoon Mountain, Alabama. Here was organized a company, called the «Raccoon Roughs,» of which he was elected captain. This company was assigned to the 6th Alabama infantry, in which he rapidly rose through successive grades to that of colonel (28 April 1862). At Seven Pines, through the wounding of General Rodes, the command of the brigade fell upon him; and at Malvern Hill he led it in the grand charge of D. H. Hill's division against the Federal posi-

tion. At Sharpsburg he was five times wounded. On 1 Nov. 1862 he was commissioned brigadier-general with command of a Georgia brigade of six regiments, which he led with great distinction at Chancellorsville and Gettysburg. On the march into Pennsylvania, just before the battle of Gettysburg, he reached Wrightsville on the Susquehanna, making the most extended advance achieved in the East by Confederates during the war. On the first day at Gettysburg he struck the extreme right of the Union army in Ewell's grand turning movement, by which the victory so desperately striven for by A. P. Hill was secured, and the Federals were driven through the town of Gettysburg to the heights beyond. On 6 May 1864, in the Wilderness leading two brigades, he fell at sunset upon Sedgwick's corps, driving the Federals from a large part of their works and capturing 600 prisoners, including Generals Seymour and Shaler.

On 12 May at Spottsylvania Court House, commanding Early's division, immediately after Hancock had overwhelmed Edward Johnson, Gordon by an impetuous charge first checked the Federals and then drove them back to the base of the salient, where the fight continued with great fury to the close of the day. Two days later Gordon was commissioned major-general and placed in command of Evans' Georgia brigade, Hays' and Stafford's Louisiana brigades, and Terry's Virginia brigade — the latter being made up of the remnants of the "Stonewall" brigade and other Virginia troops. With this command he participated, under Early, in the defeat of Hunter's expedition, the invasion of Maryland, the victory at the Monocacy, the march into the suburbs of Washington, and the battles against Sheridan in the Shenandoah Valley, being especially distinguished in the surprise and rout of Sheridan's army in the early morning at Cedar Creek. Having been assigned to the command of the Second corps of the Army of Northern Virginia, he held his lines with great tenacity, and in March 1865 made the brilliant dash by which he captured Fort Steadman and parts of the line to the right and left of it. Owing to the failure of the supporting column to arrive in time, he was obliged to retire to his original position. On the retreat from Petersburg he protected the rear, and at Appomattox commanded half of Lee's army, making a last brilliant charge of that heroic but now fearfully depleted host. After the surrender he called his men about him and made them a speech remarkable for its strong declarations of faith in God and earnest exhortations to endure defeat with patience, obey the laws, and rebuild their ruined homes and fortunes. He became the trusted leader of his people, was twice elected governor of Georgia, and for two terms represented his State in the Senate of the United States, on all occasions using his influence for peace and fraternity between the late warring sections. As commander-in-chief of the United Confederate Veterans' Association he possessed the enthusiastic love and devotion of his comrades, who would never entertain the idea of his retirement from the office to which they every year elected him, declaring repeatedly that death alone could remove him from that post of honor. His very successful lecture on 'The Last Days of the Confederacy' was well known in both North and South. His war-time reminiscences began to appear in 'Scribner's Magazine' in 1903 and were later published in book form.

Joseph T. Derry,
Author of 'The Story of the Confederate States.'

Gordon, Joseph Claybaugh, American educator: b. Piqua, Ohio, 9 March 1842. He was the earliest American advocate of oral education for the deaf and in 1869 organized the oral department of the Indiana Institution for the Deaf. He was professor of mathematics and chemistry in Gallaudet College, Washington, 1873–97, becoming superintendent of the Illinois Institution for the Education of the Deaf in the last named year. He has published: 'Education of Deaf Children'; 'Notes and Observations on the Education of the Deaf'; etc.

Gordon, Julien. See Cruger.

Gordon, William W., American soldier: b. Savannah, Ga., 14 Oct. 1834. Graduated from Yale in 1854, he served in the Confederate army during the Civil War, distinguishing himself at the battle of Frederick City, Md., and subsequently was in the cotton trade at Savannah. He was for six years a member of the State legislature of Georgia, was brigadier-general of volunteers in the Spanish-American war (mustered out 1899), and was appointed to the evacuation commission for Porto Rico.

Gordon-Cumming, Constance Frederica. See Cumming, Constance.

Gore, Christopher, American statesman: b. Boston 21 Sept. 1758; d. Waltham 1 March 1827. He was graduated at Harvard College in 1776, and studying law, was soon engaged in good practice. In 1789 he was appointed the first United States district attorney for Massachusetts; in 1796 was chosen one of the commissioners to settle the claims of the United States upon Great Britain for spoliations, and remained in London, successfully engaged in the duties of this office, about eight years. In 1803 he acted as *chargé d'affaires* during the absence of the American minister; in 1809 was chosen governor of Massachusetts; and in 1814 was elected to the United States Senate. He left about $100,000 to Harvard College. Gore Hall, the library building at Harvard, is named in his honor.

Gorgeana, gôr-jē-ăn'a, Me., now York, the first incorporated city in the United States. On 2 Dec. 1631 a grant was made to Sir Ferdinando Gorges and others of 24,000 acres on both sides of the Accomenticus (Agamenticus, now York) River. Settlements were founded here, and on 10 April 1641 were formed into a borough named Accomenticus or Agamenticus which on 1 March 1642 was given a city charter as Gorgeana, with a full apparatus of mayor, aldermen, courts, etc. It had an extent of three miles on the coast and seven up the river, a small tidal stream. In 1652 Maine submitted to Massachusetts; and to avoid the city charter and Gorges' rights, Gorgeana was reincorporated as the town of York.

Gorges, gôr'jĕz, Sir **Ferdinando,** colonial proprietor of Maine: b. Ashton, Somersetshire,

about 1565; d. 1647. He was a partner in the conspiracy of the Earl of Essex, against whom he testified on his trial in 1601. When Waymouth returned in 1605 from his voyage to North America, and brought with him five Indian captives, Gorges took three of them into his house, caused them to be instructed in the English language, obtained information from them of the "stately islands and safe harbors" of their native country, and determined to become a proprietor of domains beyond the Atlantic. He persuaded Sir John Popham, lord chief justice of England, to share his intentions, and in 1606 the king incorporated two companies, the London colony, and the Plymouth colony, between which was divided the territory extending 50 miles inland from the 34th to the 45th parallel north latitude. The Plymouth colony had the northern portion, which was styled North Virginia. Three ships with 100 settlers sailed from Plymouth 31 May 1607, and reached the mouth of the Kennebec in Maine, where they began a settlement, abandoned the next spring. In 1616 Gorges sent out Richard Vines with a party, which encamped on the river Saco through the winter. In 1620 Gorges and his associates obtained a new incorporation for "the governing of New England in America," which was empowered to hold territory extending westward from sea to sea between the 40th and 48th parallels north latitude. Gorges himself united with John Mason in taking grants of the district called Laconia, bounded by the Merrimack, the Kennebec, the ocean, and "the river of Canada," and under his auspices several settlements were attempted. His son, Robert Gorges, was appointed in 1623 by the council for New England "general governor of the country." This council resigned its charter to the king in 1635, and the elder Gorges now determined to establish a miniature sovereignty on his own domain. To this end he obtained from the king a charter constituting him lord proprietary of the province of Maine, with extraordinary governmental powers, to be transmissible with the property to his heirs and assigns. He sent his son Thomas to be deputy governor, and the officers took an oath of allegiance to the lord proprietary. The province was divided into two counties, of which Agamenticus (now York) and Saco were respectively the principal settlements; the former received a city charter, as Gorgeana, in 1642. But the fatal want was a deficiency of subjects; probably two thirds of the adult males were in places of authority; yet the little monarchy continued for nearly 10 years. When the four New England colonies formed a confederacy in 1643, the settlements of Gorges were excluded from it. On Gorges' death his colonists at length formed themselves into a body politic for the purposes of self-government, and submitted to the jurisdiction of Massachusetts. "The nature of Gorges," says Bancroft, "was generous, and his piety sincere. He sought pleasure in doing good, fame by advancing Christianity among the heathen, a durable monument by erecting houses, villages, and towns."

Gorgias, gôr'jĭ-as, Greek orator and sophist: b. Leontini, in Sicily. He flourished in the 5th century B.C., and was one of the earliest writers on rhetoric. He was one of the first who introduced cadence into prose. He also treated of common-places, and showed the use of them for the invention of arguments. This induced Plato to give the name of 'Gorgias' to his elegant dialogue on this subject. Gorgias is said to have reached the extraordinary age of 107 or 108 years. Two works attributed to him are extant, 'The Apology of Palamedes,' and the 'Encomium on Helena,' but their genuineness has been questioned by several critics. See Jebb, 'Attic Orators.'

Gorgo, gôr'gō, or **Gorgon**, according to Homer, one of the frightful phantoms of Hades; but Hesiod mentions three Gorgons, Stheno, Euryale, and Medusa. They were all immortal, except Medusa. Their hair was entwined with serpents, their hands were of brass, their body covered with impenetrable scales, their brazen teeth as long as the tusks of a wild boar, and they turned to stones all those who looked upon them. According to some authors, Perseus, when he went to the conquest of the Gorgons, was armed with an instrument like a scythe, by Hermes, and provided with a looking-glass by Athena, besides winged shoes and a helmet of Pluto, which rendered all objects clearly visible and open to the view, while the person who wore it remained totally invisible. With weapons like these Perseus obtained an easy victory. The head of Medusa remained in his hands, and he gave it to Athena, who placed it on her Ægis, with which she turned into stones all such as fixed their eyes upon it. The residence of the Gorgons was beyond the ocean toward the west, according to Hesiod.

Gorgo'nia, the type-genus of the *Gorgonidæ*, a family of alcyonarian coral-polyps, the "sea-fans" or "sea-whips," which have a calcareous or horny axis, the colony often greatly branched, and the branches anastomosing. In the common gorgonia (*Rhipigorgia flabellum*) of the West Indies and Florida Keys the branches form a flat net-work. In this and other sea-fans the short calicles of the single retractile polyps stand perpendicularly to the axis, communicating by longitudinal vessels and branching canals. While by far the greater majority of the species are inhabitants of tropical waters, in the Arctic seas, and in the deeper, cold waters of the Newfoundland banks, and on St. George's Bank, two large species occur: *Primnoa reseda* and *Paragorgia arborea*; the latter is of great size, the stem being as thick through as a man's wrist, and the entire coral-stock over five feet in height.

Goril'la. This term is derived from the 'Periplus' of the Carthaginian navigator, Hanno, who described, 500 years before Christ, an island on the west coast of Africa as full of wild men, which his interpreter called Gorilloi. When, therefore, Dr. Thomas Savage brought the first specimen of this animal to the attention of science, in 1847, the name "gorilla" was naturally applied to it. It now appears probable that the "Gorilloi" of Hanno were probably baboons. The gorilla of science, of which but one species is known (*Gorilla gorilla*), is the largest of the apes and is of great interest, since with the chimpanzee and the orang-outang, it is the nearest living relative of man. Structurally it is very closely allied to the chimpanzee. It does not exceed 5½ feet in height, but in bulk con-

siderably exceeds man. Its skin is black, the hair being blackish and turning gray in old individuals. The skull has the supraorbital ridges greatly developed and the crest in the sagittal line is large. The arms are long, the hand reaching to about the middle of the shank, while the hands are webbed to the end of the first joint of the fingers. In the foot the heel is more apparent than in other anthropoid apes, correlated with its more terrestrial life. They usually walk upon all fours, a gait rendered possible by the very long arms.

These apes are limited in their distribution to the forested region of the Gaboon, and go about in families led by an old male. They are mainly diurnal in their habits, seeking their food, which is largely vegetable, during the day. At night the female and young are said to ascend a tree while the male sleeps at its foot. The stories told of its ferocity are possibly exaggerated, yet it is without doubt an extremely dangerous animal when brought to bay. When making an attack the male stands erect and is said to knock his adversaries down with his hand and then to use his powerful teeth, the canines of which are greatly developed. Consult: Keith, 'Proceedings Zoological Society of London' (1899); for accounts of its habits: Huxley, 'Man's Place in Nature'; H. O. Forbes, 'Monkeys' (1894); and Hartmann, 'Anthropoid Apes' (1885).

J. S. Kingsley,
Professor of Zoology, Tufts College.

Gor'ky, Maxim, pen name of Alexei Maximovitch Pyeshkoff, Russian author: b. Nijni Novgorod 1868. He traveled over a large part of his native country as a tramp after serving in many employments from that of a ship's cook to that of a lawyer's clerk. The varied scenes and persons he saw in his vagabond life among the lowest of the population furnished him with rich material for his subsequent literary work, in which he takes upon himself to interpret *la misère* as it is in western and southwestern Europe. His style is like a flash-light revealing features of debased or tragic character with vivid realism, but his view of his subject is tinged with melancholy pessimism. Among his most admired works are: 'Foma Gordyeeff' (1902); 'Makar Chudra' (1892).

Gor'man, Arthur Pue, American legislator: b. Howard County, Md., 11 March 1839. Up to his 27th year he was a page in the United States Senate. He was then appointed Collector of Internal Revenue in the Fifth District of Maryland. In 1869 he was made general superintendent of the Chesapeake and Ohio Canal Company. Since 1872 he has been president of that corporation. His influence as a Democrat has extended from the affairs of Maryland to those of the United States in general, and from the House of Delegates in his native State he was elected in 1893 to serve as Senator of the United States; to which office, after three years of private life, he was re-elected in 1902. He was prominent in opposing the Force Bill of 1889 and took part in the reframing of the Wilson Tariff Bill in 1894.

Gorringe, gôr'rĭnj, **Henry Honeychurch,** American naval officer: b. Barbadoes, W. I., 11 Aug. 1841; d. New York 6 July 1885. He came to the United States in youth, entered the Union navy in 1862, and served under Admiral Porter. He was promoted lieutenant-commander in 1865. He accomplished the removal of the Egyptian obelisk (Cleopatra's Needle), which the khedive had presented to the United States, from Egypt to New York city in 1880. He published a 'History of Egyptian Obelisks' (1885).

Gorse, or **Whin.** See Furze.

Gortchakoff, gŏr-chä-kof', **Alexander Mikhail'ovitch,** Russian diplomatist; cousin of the general of the same name: b. St. Petersburg 16 July 1798; d. Baden-Baden 1 March 1883. He entered the diplomatic service in 1824 as secretary to the Russian embassy in London. His experience in diplomacy was extended in Vienna, Florence, Stuttgart, and elsewhere, and he showed great skill in securing the neutrality of Austria during the Crimean war. In 1856 he became minister of foreign affairs, and in 1862 chancellor of the empire, having by that time made himself one of the foremost diplomatists of Europe. He was a prominent member of the Berlin Congress 1878, but his influence was then on the decline, and in 1882 he was superseded by M. de Giers.

Gortchakoff, Prince **Mikhail,** Russian general: b. 1795; d. Warsaw 30 May 1861. He took part as an artillery officer in the battle of Borodino in 1812, and served in the subsequent campaigns of the allies against the French. He acquired also a brilliant reputation in the Polish war of 1831; and in 1846 he was made governor of Warsaw. In 1855 he was appointed commander-in-chief in the Crimea, where he conducted the defense of Sebastopol. In 1856 he returned to Poland as governor of the country. By his express desire his body was carried to Sebastopol, and buried in the place he had so long and so bravely defended.

Gor'ton, Samuel, New England enthusiast, and first settler of Warwick, R. I.: b. Gorton, England, about 1600; d. Rhode Island November or December 1677. He did business in London as a clothier until 1636, when he embarked for New England, and settled at Boston. Religious disputes induced him to remove to Plymouth, where we first hear of him as a preacher. He soon exhibited such peculiar views that he was banished from the colony on a charge of heresy. With a few followers he then went to Aquetneck or Rhode Island, which had recently been settled by exiles from Massachusetts Bay; but falling again into trouble, was publicly whipped for calling the magistrates "just asses" and for other contemptuous acts, and was forced to seek an asylum with Roger Williams in Providence, about 1641. Here he became involved in the disputes of the colonists on certain questions of boundary. Gorton was then summoned to Boston, but refused to recognize the jurisdiction thus assumed, and about the same time removed to Shawomet, on the west side of Narragansett Bay, where he purchased land from the Sachem Miantonomo. But in June 1643 two inferior sachems contested his claims to the land, and applied to the general court at Boston for assistance. A body of 40 soldiers was consequently marched to Shawomet, and Gorton and 10 of his disciples were carried to Boston and condemned to hard labor, a sentence commuted to banishment in 1644. Gorton then went to

England, where he obtained from the Earl of Warwick an order for the land he claimed. Returning to Rhode Island in 1648 he founded the town of Warwick, thenceforth his home, and where he occasionally preached. He wrote several controversial works, the best known of which is 'Simplicitie's Defense Against Seven-Headed Policy' (1646). See Janes, 'Samuel Gorton' (1896).

Goschen, gō'shĕn, **George Joachim,** Viscount, English financier: b. of German extraction London 10 Aug. 1831. He was educated at Oxford and entered Parliament as a Liberal for the city of London in 1863, which he represented till 1880. He was First Lord of the Admiralty, 1871–4. With M. Joubert he went to Egypt in 1876 on behalf of the bond-holders to reorganize the finances of that country, and two years afterward represented Great Britain at the international monetary conference held in Paris. In 1887 he became chancellor of the exchequer under Lord Salisbury, and in 1895 again took office under the same leader as First Lord of the Admiralty. From this office he retired toward the end of 1900, and was soon after raised to the peerage as Viscount Goschen. He represented Ripon in Parliament 1880–5, when he was returned for Edinburgh, and was member for St. George's, Hanover Square, 1887–1900. He is author of several financial and political pamphlets, and of a well-known work on the 'Theory of Foreign Exchanges' (1864).

Gos'hawk, a falcon of the genus *Astur*. The goshawk proper, or "gentle falcon" (*A. palumbarius*), was a favorite bird in falconry (q.v.), and is still used for large game, as rabbits, pheasants, and the geese from which it took its name. It is 21 inches in length, the crown, black, bordered on each side by a line of white, finely speckled with black; upper parts, slate, tinged with brown; legs, feathered half-way down, and, with the feet, yellow; tail-feathers with pale bands. It is to be found throughout Europe and central Asia; and it is a question whether the American goshawk (*A. atricapillus*) is really specifically different. The latter is a noble bird whose home is in the North, so that it is rarely seen south of the Canadian line except in winter, and uncommonly then. In its boldness, its marvelous power and control of flight, and its prey, it resembles our more familiar little falcons, the sharpshin and Cooper's hawk. Several other species inhabit the Orient, an Australian one being remarkable for its pure white color, with red irides.

It should be noted that the bird called "goshawk" in Scotland is the peregrine.

Goshen, Ind., city, county-seat of Elkhart County; on the Elkhart River, and on the Cleveland, C., C. & St. L., and the Lake Shore & M. S. R.R.'s; about 25 miles southeast of South Bend and 95 miles southeast of Chicago. It is situated in a fertile agricultural section of the State. Its principal industrial establishments are flour-mills, bicycle and machine shops, woolen-mills, sash and door factories, veneering and furniture shops; rubber goods, underclothing, mittens, and shirts are manufactured here. The city has large lumber, coal, and brick yards. Hay, grain, and live stock are the chief farm products shipped from Goshen to larger markets. The public library building and the high-school are the principal public buildings. The mayor holds office for two years. The city owns and operates the electric light plant and the waterworks. Pop. (1900) 7,810.

Goshen, N. Y., a village, railroad junction, and one of the county-seats of Orange County; on the New York, L. E. & W. and the Lehigh & N. E. R.R.'s; 59 miles northwest of New York. Goshen was founded in 1714, and incorporated in 1809; it has municipal waterworks. The manufactures include bricks, tiles, glass, cider, and foundry products, but the chief commercial interests are connected with the dairying industry, there being a considerable trade in milk, butter, and cheese, which are widely celebrated for their excellence. Pop. (1900) 2,826.

Gosling-grass. See Bedstraw.

Gosnold, gŏs'nōld, **Bartholomew,** English voyager to America: d. Jamestown, Va., 22 Aug. 1607. He joined Raleigh in his attempt to colonize Virginia, and after the failure of that enterprise was placed in command of an expedition fitted out at the cost of the Earl of Southampton and others for planting a settlement in New England. He sailed from Falmouth 26 March 1602, with one small vessel and a company of 32 persons, 20 of whom were colonists. Steering directly across the Atlantic, in seven weeks he reached Massachusetts Bay, first seeing land probably not far north of Nahant. Thence he turned south and landed on Cape Cod, to which he gave the name it still bears. Sailing around the promontory, and stopping at the island now known as No Man's Land, but which he called Martha's Vineyard, Gosnold anchored at the mouth of Buzzard's Bay, and resolved to plant his colony on an island which he called Elizabeth, and which now bears the Indian name of Cuttyhunk. The adventurers here built and fortified a house, but the hostility of the Indians, scarcity of provisions, and disputes about a division of the profits, disheartened them, and the whole party returned to England, taking a valuable cargo of sassafras root, then highly esteemed as a medicine, cedar, furs, and other commodities. Gosnold next turned his attention toward Virginia, and after long effort succeeded in organizing a company for colonization in that region, the heads of which were Edward Wingfield, Robert Hunt, and the famous Capt. John Smith. A charter was granted them by James I., 10 April 1606, the first instrument of that nature under which the English were planted in America; and on 19 Dec. 1606 Gosnold set sail with three small vessels and an ill-assorted band of 105 adventurers, only 12 of whom were laborers, and very few mechanics. After a tedious voyage, a storm having driven them into Chesapeake Bay (26 April 1607), they sailed up James River, which they named after the king, disembarked about 50 miles above its mouth, and founded the settlement of Jamestown. Sickness and various disasters destroyed 50 of their number before autumn, among whom was the projector of the colony. The Massachusetts township of Gosnold, comprising the Elizabeth Islands, was named in his honor.

Gospels. Our four gospels cannot perhaps be better described than by calling them "Memoirs of Jesus." Though they contain ample historical and biographical materials,

they are neither histories nor biographies, in our modern sense of these terms. Moreover, each one has been written with the distinct purpose of edification. They do not relate facts simply as facts, but always with the object of awakening or strengthening faith. Each Evangelist has selected and arranged his materials in accordance with his conception of the best way to realize this aim. Altogether they give us but a small part of the life and activity of the Master, and yet they contain enough to make clear His character and mission. The recognition of these general characteristics is indispensable in the consideration of the critical questions which are connected with the study of the origin and interrelation of the four Gospels. In distinction from that of St. John, the first three gospels, since the days of Griesbach (latter part of 18th century) have been called "the Synoptics," for the reason that their accounts which are often parallel, give us a general view of the sayings and doings of Jesus. They differ from that of St. John in four particulars: (1) In the scene of Jesus' ministry, St. John confines himself almost entirely to Judea, while they are busy with the ministry in Galilee and the Perea. (2) In the number of Passovers noted. The Synoptics mention only one; St. John, at least three (ii. 13, vi. 4, xii. 1). Hence, so far forth, there seems to be a difference in the duration of the ministry. (3) In the events narrated. Apart from the events of the last or Passion week, St. John gives only three incidents in common with the other Gospels — the feeding of the multitude, vi. 1-13, the walking on the water, vi. 16-21, the anointing of Jesus by Mary of Bethany, xi. 55, xii. 11. (4) In the general teaching of Jesus. St. John's Gospel, as far as its teachings are concerned, deals quite exclusively with the person of Jesus, while the others make known to us the nature of the kingdom which he came to establish. These differences have made the fourth Gospel the subject of much study and speculation, and cause it still to be one of the difficult problems of New Testament criticism.

The Synoptic Problem.— For over 100 years students of the Gospels have been engaged upon the question of the origin and relationship of the Synoptic evangelists. No one can read these gospels attentively without being struck with the general resemblances in the narratives. These resemblances pertain to the place of our Lord's ministry — Galilee, to the time — only one Passover being given, and to the general order of events. More than one half of the incidents are the same in all three, and what is noteworthy regarding these is the close similarity in the language in which the incidents are given. Such facts point to a common relationship of some kind. Together with these resemblances, however, there are just as marked differences. The character as well as number of these differences is striking. What origin can account for both resemblances and differences? This is the Synoptic problem. In the course of the long period of work upon it, three typical solutions have been offered: (1) The solution of inter-dependence. This supposes that the Evangelists copied from one another and there have been as many variations in the form of the theory as there are possible orders of the Gospels. No one of them has proved satisfactory. Out of the discussions that were begotten, however, one important question early became prominent, and that was regarding the Gospel of St. Mark. Did St. Mark make his Gospel by compiling his account from the other two, or was his shorter narrative the basis of St. Matthew's and St. Luke's narrative? Griesbach brought Germany to accept the former view, and for a long time this view stood in the way of any advance in the criticism of the Gospels. That St. Mark is not an epitome or compilation of the other two, is now one of the assured results of criticism. As it became more and more evident from repeated attempts to show it, that the use of one gospel by another in the way of direct copying could not be defended, attention was turned to a possible origin back of them all — to some primitive form of gospel, which would explain all the facts. Hence (2) the solution by the supposition of a primitive gospel. By some (Eichborn, Ewald) this primitive gospel was supposed to be written; by others (Gieseler, Lange, Westcott, Godet) oral. The insurmountable objection to the method of solution by a primitive written source was in the number of translations and recensions postulated in order to account for our gospels in their present form. Eichborn and Ewald supposed nine such stages of work. These theories have proved too intricate and artificial for acceptance. The chief objections to the hypothesis of a primitive oral gospel, as directly the source of our gospels are: (1) That the supposition of some central apostolic tradition formed in or about Jerusalem makes it very difficult to account for the Gospel of St. John. Why did this tradition omit all that is found in the fourth Gospel? (2) "The agreement between the Gospels, in many instances, extends to phrases which are mere connecting links between the sections, which are just the kind that in fully oral tradition would be the first to vary." (3) "The likeness between the Gospels is not confined to agreement in the way of telling separate stories, but extends also to the order of arrangement (ex. Matt. xiv: 1, Mark vi: 14, and the way both narratives go back and explain the statement of the beheading of John). Criticism has not, however, cast away all that these theories have offered us. It is unquestionably true that the gospel existed first in an oral form, and it is also true that the oral gospel was in great part committed to writing before it became the content of our gospels. The solution, therefore, which is to-day accepted by the majority of scholars is that which postulates two main written sources. One of these is called the "Logia," and is attributed to St. Matthew; the other is "a narrative of events," attributed to St. Mark and taken by him from St. Peter. This conclusion reached by the way of patient, careful criticism, singularly accords with the testimony of Papias (see Eusebius, Hist. Ecc. III.), who says: "St. Mark, having become the interpreter of St. Peter, wrote down accurately, though not indeed in order, whatsoever of the things said or done by Christ." "St. Matthew wrote the oracles (Logia) in the Hebrew language, and everyone interpreted them as he was able." Several perplexing questions, however, have arisen in regard to each source, and all of them have not as yet been satisfactorily answered.

Let us look at them in order. In regard to the "Logia," the first question is, "What was their character?" Were they simply discourses, or discourses plus some introductory narrative material? One of the best discussions of this question is to be found in Lightfoot's 'Essays on Supernal Religion' (Essay on Papias). There is now general agreement in the judgment that they include an element of narrative. Again, "How are they related to the Gospel of St. Matthew?" The answer is that they form a large part of the Gospel, and for that reason have given to it the name of Matthew, though he did not write the book as we now have it. The original Matthew (Ur-Matthæus as Weiss calls it) contained simply the Logia, with a small number of incidents. The third question is, "In which Gospel do we get the Logia in their original form, in the book of St. Matthew or in that of St. Luke?" The best answer which has yet been given to this difficult question is this: "That the balance of probability is on the side of St. Luke's Gospel," and mainly for the reason that in St. Matthew we have aggregated unities like the Sermon on the Mount, the charge to the Twelve (chap. x.), the Parables by the Sea (chap. xiii.). In regard to the other source — The Narrative of Events — the first question of importance is this: Is our Gospel of St. Mark the original Narrative of Events? The description of Papias is confirmed by Irenæus, Clemens, Alexandrinus, Tertullian, Origen, Eusebius, and Jerome, so that there is sufficient witness to the relation of Mark and Peter, and the answer which criticism has given to the above question is, "that the Petrine source used by the two later synoptists was not an Ur-Markus, but St. Mark's Gospel, almost as we have it now."

Every student of the problem knows that these two "main documents," satisfactory as they are as the principal sources of Matthew and Luke, are only the "main sources." St. Luke has gone elsewhere for parts of his Gospel, and the relation of St. Matthew to St. Luke requires the supposition of more material than the Logia gives. Oral tradition has probably had its place along with written records. The problem yet requires much patient painstaking study.

The Gospel of St. Matthew.— (*a*) *Authorship.*— Papias is the first to tell us about a form of gospel written by St. Matthew (Eusebius H. E. III: 39) and Irenæus (Adv. Hae III : 1, 1), the first to name St. Matthew as the author of the first gospel. Just in what sense these statements are facts we must see later. Meanwhile a word about St. Matthew himself. He was a tax-gatherer before his acceptance of the call of Jesus (Matt. ix. 9). Promptly responding to the invitation of the Master to follow him, he became an eye-witness of much of the Lord's ministry. There is no good reason for denying his identity with the Levi of St. Mark ii. 14, Luke v. 27. Both his position as a tax-gatherer, requiring work with the pen, and his experience as a disciple fitted him to do the work which tradition has assigned to him.

Papias and Irenæus refer to this work as in Hebrew (Aramaic), but our first gospel is in Greek, and it gives no evidence of being a translation from a Hebrew original. The question then arises, what is the relation of our Greek Matthew to the Hebrew Matthew of tradition? Criticism in seeking to answer this question has reached the following conclusions: (1) That the Gospel according to the Hebrews, in either of its forms, Ebionite or Nazarene, was not identical with the Aramaic original of St. Matthew's Gospel; nor is our Greek Matthew a translation of the Gospel to the Hebrews. (2) That the Aramaic original of which Papias and Irenæus speak, was probably the collection of discourses now known as the Logia, compiled by St. Matthew, having very little narrative material, and reflecting in character the needs and conditions amid which these Logia at first took shape (See Weizäcker, Apostolic Age, Vol. II., chap. ii.) (3) That this Aramaic source has entirely disappeared. (4) That our present Gospel of St. Matthew originated in a desire to "expand the old Apostolic source, whose form no longer met the needs of the time, into a history of the life of Jesus which would correspond to these." (5) That the framework of St. Mark's Gospel was used for the narrative setting, but because of the importance and value of the discourse element, the resultant production was called the Gospel according to St. Matthew. (6) That other narrative material such as Chapters i., ii., xxviii., were taken either from other sources or from oral tradition (Weiss). (7) That this composite Gospel existed only in Greek form and is of unknown authorship. Space forbids entering upon the evidence for each of these statements; it can be found in the literature given at the end of the article.

(*b*) *The Purpose of the Gospel.*— It aims to show that Jesus was the Messiah, not in the way John does, by making evident the glory of His person in word and deed, but through the fulfilment of Old Testament prophecy. The author seeks at each step of the history to prove by Messianic prophecies (there are over 70 quotations and references to the Old Testament) the Messiahship of Jesus. This compels him to meet the objections of the Jews and also to lay bare their motives in opposing the teaching and claims of the Master. While, therefore, the Gospel is meant to strengthen and comfort Jewish Christians, it also has, as Godet claims, an apologetic aim.

The Gospel of St. Mark.— (*a*) *Authorship.* —There has been no reason discovered for disbelieving the testimony of Papias that Mark — the John Mark of Scripture — has given us in substance the "Memoirs of Peter" regarding Jesus. Some difference of opinion exists as to the meaning of the description "interpreter"— it being understood by some as the equivalent of "amanuensis"; by others as "translator." The Gospel bears abundant witness to the character of its depictions as being those of an eye-witness. They are circumstantial, pictorial, and vivid. Papias further says that "having become the interpreter of St. Peter, St. Mark wrote down accurately, though not indeed, in order, whatsoever he remembered of the things said or done by Christ." This statement about order, whatsoever he remembered of the things events given in the Gospel, which is progressive and helpful in understanding the public career of Jesus, but to the sequences of events in detail. A topical rather than a chronological plan is followed (see Bacon's 'Introduction to the New Testament,' pp. 189–190). So good is

this order of St. Mark that both St. Matthew and St. Luke use it. Evidences of other sources besides the Petrine Memoirs are found, for example, in chapter xiii., for which the supposition of a separate written document seems needful; so too the narrative about Herod in chapter xiv. St. Mark adds some touches of his own.

(*b*) *The Purpose of the Gospel.*— The purpose of this vivid presentation of the activities of Jesus in Galilee and during the latter days in Jerusalem was not the mediating of the antagonistic tendencies in the church (Baur), nor the commendation of Paulinism (Pfleiderer), nor to counteract the effect of the delay in Christ's coming by making evident the Messianic character of the mission of Jesus (Weiss), but simply to show how "God anointed Jesus of Nazareth with the Holy Ghost and with power" and how He "went about doing good and healing all that were oppressed of the devil: for God was with him" (Acts x. 38). These are St. Peter's own words descriptive of the mission of Jesus. His Gospel gives the content of that description. Of course, the narrative was meant to be a support to faith and a means of winning men to faith.

The Gospel of St. Luke.— (*a*) *The Author.*— The Muratorian Fragment (c. 200 A.D.) is the earliest external witness to the name of St. Luke as the author of the third Gospel, "the third book of the Gospel, that according to Luke, the well-known physician." Irenæus follows with explicit testimony to the same effect, and all early tradition but seconds these witnesses. St. Luke was born, according to tradition, in Antioch, and was a Gentile. Godet's account of the strict supervision under which physicians were placed by the authorities at Rome argues an amount of culture for St. Luke quite above that of other men. St. Luke's name appears but three times in Scripture, Col. iv. 14, Philemon 24, 2 Timothy iv. 11. Of late years we have come to know him more fully as a writer, through the critical study of the Acts; and his character as a careful, philosophic historian has been ably set forth by Prof. Ramsay. (See Ramsay's 'St. Paul the Roman Traveller.') The common authorship of the Acts and the third Gospel is now generally accepted.

(*b*) *The Sources of the Gospel.*— The Introduction of the Gospel gives the author's plan of procedure and his purpose. Just what is involved in its designation of sources is difficult to say. He does not tell us whether they were oral or documentary, whether in Aramaic or Greek. The problem of the sources of St. Luke's Gospel is a complicated one, and entire unanimity has not been reached in its attempted solution. The following conclusions will give, in brief, some conception of the situation. (1) St. Mark's Gospel is one of his chief sources. Almost all of the contents of St. Mark (except vi. 45–viii. 26) are found in the third Gospel. Evidently St. Luke has used the Gospel of St. Mark as his framework, and here again criticism sees no need of postulating an Ur-Markus. It is to be noticed, however, that he omits some things recorded by St. Matthew and St. Mark, and records some things which St. Matthew and St. Mark omit. The explanations of this phenomenon have been different, but they have not invalidated the conclusion given above. (2) While St. Luke knew the Logia document in its original form, he was not familiar with our present Greek Matthew. The main reason for the latter part of this statement is discoverable in the way St. Matthew and St. Luke use the Gospel of St. Mark. "It is established," says Weiss, "as one of the indisputable results of Gospel-criticism that St. Luke's acquaintance with and use of the Apostolic source of the first Gospel is just as certain as his want of acquaintance with this Gospel itself." Where St. Matthew and St. Luke have material in common which is not found in St. Mark, another document is supposed to be the source, or oral tradition. (3) St. Luke has placed the great mass of the material which he took from the Apostolic source in the two sections which he has inserted into St. Mark's narrative, namely, in vi. 20–viii. 4, ix. 51–xviii. 14. (4) Besides these two main sources, the narrative of St. Mark and the Logia, St. Luke had other written sources, giving him the first two chapters, and the long Perean section. These may, indeed, have been parts of one source, which contained material covering the entire life of Jesus. The effect of St. Luke's hand, and the modifications of oral tradition are evident throughout the book. The uniformity of style and diction in the whole Gospel show that these varied sources were not merely put together, but were edited by St. Luke. The peculiarities of his Greek appear all through the Gospel.

(*c*) *The Purpose of the Gospel.*— It was written that Theophilus "might satisfy himself of the accuracy of the story which he had heard from others" (i. 4). Its appeal, through Theophilus, is to the Gentiles. "Luke," says Origen, "composed his Gospel for Gentile converts." In accord with this are its depiction of the humanity of Christ — the ideal man — and its broad spirit of universality.

Date and Integrity of the Synoptic Gospels.— (*a*) *Date.*— Much division of opinion exists as to the time of the writing of the Synoptic books. The materials out of which they were made originated, of course, much earlier than the gospels themselves. The time just before or just after 70 A.D. is that which now meets with much favor. Between 70–80 A.D. is the latest probable time for dating them.

(*b*) *The Integrity of the Gospels.*— Criticism has directed its attack mainly against the following parts of the Gospels: (1) Against the first two chapters of St. Matthew and St. Luke. The chief objections to these are (*a*) the wide differences in the accounts of the birth and infancy. (*b*) The character of the accounts themselves, containing angelic appearances, the visit of Magi, and the slaughter of the Innocents. (*c*) The miraculous conception. It is to be noticed that the difference in the accounts is fully explicable in the supposition that they are from different sources. St. Luke's story is undoubtedly from the Blessed Virgin Mary, and much in St. Matthew's story is traceable to Joseph. St. Luke's account in its delicacy, personages, and fidelity to the Old Testament point of view is inexplicable as a later Jewish-Christian fiction. Perhaps the angelic appearances are simply poetic descriptions of the conveyance of inward truths and facts. The story of the Magi has a rational explanation in an astrologer's interest in a planetary conjunction at a time when the widespread hope of a Messiah among the Jews would give it for these students of the heavens, a vital significance. Herod's

well-known cruelty makes easily possible the massacre at Bethlehem. For the difficulties connected with the enrollment of Quirinius, see Prof. Ramsay's 'Was Christ born in Bethlehem?' After a possible satisfactory explanation of the attendant circumstances of the supernatural birth of Jesus, there yet remains an objection to the supernatural birth itself. This must be met on philosophic grounds, for it is really a philosophic objection. These chapters of Matthew and Luke are textually as well supported as any in the Gospels, and they have early and continued attestation in the Church. The silence of the New Testament regarding the miraculous conception is no argument against it, simply because of the nature of the subject.

(2) Again criticism has given special attention to the last 12 verses of St. Mark. The generally accepted conclusion is that these verses are a later addition to the Gospel, but that they embody a genuine apostolic tradition.

(3) The accounts of the Resurrection have also been the subject of destructive criticism. Here again we must distinguish between the accounts of the Resurrection, and the Resurrection itself. It has been truthfully said that "when we come to look into the narratives of the Resurrection, we find them unassimilated and unharmonized." Is this not due to the way in which our Gospels have come to us? Where so many witnesses were involved and so many occasions cited, is it not to be expected that there should be considerable variation in the testimony? The accounts have come to us from different sources. Some of them, like the walk to Emmaus, were personal memoirs; others, like those in St. John, were selected because of their value to him personally, for the purpose he has in view. There has been no studied attempt to fit them all to each other, but they all bear clear witness to the spontaneous, unmistakable acceptance of the fact of the Resurrection. Objections which go beyond this and impugn the fact, must be met on other grounds, and it is safe to say that the various theories which have involved the denial of an actual physical resurrection of Jesus, have thus far been quite inadequate to explain the faith of the Church. This leads us to mark as the great central point of attacks upon our Gospels (4) the miraculous element in them. Here is really the battleground to-day. All sane interpreters of these records will be in sympathy with the desire to avoid an exaggeration of the miraculous. This, however, is quite a different aim from that which tries to find for every miracle of Jesus a natural though wonderful method of procedure, for example, cures of the sick through the effect of a strong personality. Both philosophy and science take issue with the statements of the Evangelists in this matter. Meanwhile the study of documents shows that even in the residuum which all critics will acknowledge genuine, the miraculous element is present, and all schools of thought are compelled to acknowledge the character of Jesus itself as a miracle. The question is not now so much one of historical evidence as it is of philosophy.

The Gospel of St. John.— From the time in 1820 when Bretschneider published in Leipsic his 'Probabilities concerning the Nature and Origin of the Gospel and Epistles of John,' modern criticism has been engaged upon the problems of the Fourth Gospel. Authorship and historicity have been the two themes about which all this criticism has centred. The best history of the course of it will be found in Watkins' Bampton lectures for 1870. The day has gone by when this Gospel can any longer be called "A Philosophic Romance" or a "Theological Novel," and even since the day when Sanday reviewed the situation in the 'Expositor' (1891–2) a distinct advance has been made toward the traditional position. Partition theories are now in order, which means that we have a Johannine nucleus of history and discourse, used by another hand (preferably that of the Presbyter John) in working up the Gospel to its present shape. (See Wendt's 'The Gospel according to St. John.' We have already called attention to the differences between this Gospel and the Synoptics. It is almost entirely in consideration of the internal evidence that "problems" have arisen, for the judgment of Matthew Arnold is valid as regards the external evidence for authorship by St. John the Apostle, that "No one who had not a theory to serve would ever dream of doubting it." In order to appreciate the serious character of these problems, it will be necessary for us to consider the purpose and plan of the Gospel.

The Purpose and Plan of the Gospel.— The purpose is given in xx. 31, "These signs have been recorded that you may believe that Jesus is the Christ, the Son of God — and that through your belief you may have life in the knowledge of him." In the "glory" (i. 14) of Jesus we are to see, his interpretation to us (i. 18) in word and deed of the Father. We are called to look at Him, behind and in His work.

At once it is evident that the author is not aiming to give us a biography, nor a complete history. It certainly is not then a contradiction of history, if he chooses his material in order to make good his purpose. That he does select his materials is beyond question. The public announcement of the Messiahship of Jesus was at the Baptism. The earlier facts of His life, therefore, have no place in this Gospel. The author begins after the Temptation, when Jesus had entered upon the way of His public ministry, and is concerned only with the events of His public life. From this time each scene is to present Him to us in some new light, that at last, in the glory of them all, we shall say with St. Thomas, "My Lord and my God." Can the Gospel with such a definite plan as this be historical? Three things must be considered in making reply: (*a*) the facts themselves, (*b*) the discourses, (*c*) the representations of Christ. How are we to adjudge facts to be facts? Manifestly, by their verisimilitude as estimated from what we know from other sources of the historical situation in which they are placed.

Take for example the first chapter or the sixth, and estimate either in this way. Personages, situation, motives, and changing temper, are all alike such as only an eye-witness could give. All through the Gospel we have such evidence of an eye-witness. As far as the facts are concerned the relation of this Gospel to the Synoptics has been set forth by no one with more helpfulness than Godet (see Introduction to his Commentary on St. John). Under the two heads of (*a*) Correlations, and (*b*) Independence, he shows how the periods containing the facts fit to each other. In some instances

St. John is more truly historical than the Synoptics as, for example, in the placing of the Cleansing of the Temple, and in the dating of the Lord's death. When we come to (*b*) the Discourses, we enter a region peculiar, indeed, to the Fourth Gospel, and one which has caused much discussion. The solution of the problem which they offer will be facilitated by bearing in mind several considerations: (1) That they are for the most part, thematic — that is, they give us only great central teachings. (2) They come to us through the medium of the author's reflection.

Westcott calls our attention to the fact "that the discourses in Jerusalem show an intimate connection with the ideas which the festivals represented, which gained their full significance as men looked back upon them from the time when they had ceased to be." It was at these times that Jesus declared the meaning of His person and office, and the great themes impressed themselves upon a mind in sympathy with such forms of presentation. But the words heard in Jerusalem were larger, richer, fuller words when written down in Ephesus many years later. They record a spiritual mind's mature conception of the Master as that mind has discovered it in memories which from the first were striking and suggestive. Have we then a subjective element in these discourses? Unquestionably. Does that subjective element imperil the truth? Not in the least. It rather gives it to us in full proportions. These discourses are not a stenographic report of the words of Jesus. They are reproductions in the clear light of the Spirit's illumination. They contain the essential, eternal verities of Jesus' teaching. Hence we expect to find them all in the style of St. John, as they are; hence we expect to find interpretation added to them here and there, as we do; hence we find them grouped at times with no clear, definite situation given to them. The solution of the problem of the discourses lies not in the denial of their historicity, but in the admission of their subjectivity. The question then presents itself, "Have we the same Christ in the Fourth Gospel as in the Synoptics?" Yes; but seen from a different point of view. The Johannine Christology never rises higher than that given in Matt. xi. 25–28; Luke x. 21–22.

Authorship.— Two characteristics appear in the writer of the Fourth Gospel. (*a*) A memory for details, and (*b*) a mature, profound conception of Jesus. They point to the work of an old man, who had been an eye-witness of what he relates. It is sufficient for the purposes of this article to say that the supposition of the authorship by John the Apostle meets more of the alleged difficulties of the Johannine problem than any other supposition. Modern criticism, however, has received with much favor the name of John the Presbyter.

Literature on the Synoptic Problem.— Gloag, 'Introduction to Synoptic Gospels' (1895); Robinson, 'The Study of the Gospels' (1902); Rushbrook, 'Synopticon' (1880); Wright, 'Synopsis of the Gospels in Greek' (1896); Hawkins, 'Horæ Synopticæ' (1899); Weiss, 'Markus-Evangelium' (1872); 'Matthäus-Evangelium' (1876); Ewald, 'Das Hauptproblem der Evangelienfrage' (1890); Wendt, 'Die Lehre Jesu' (1890); Holtzmann, 'Die Synoptischen Evangelien' (1863); 'Einleitung in das Neue Testament' (1886); Westcott, 'Introduction to the Study of the Gospels' (1895); Wright, 'Composition of the Four Gospels'; Jolley, 'The Synoptic Problem for English Readers' (1893); Sanday, 'A Survey of the Synoptic Question' (1891); 'Inspiration,' Lecture VI. (1893); Burgon, 'The Last Twelve Verses of St. Mark.'

Literature of the Johannine Problem.— Thoma, 'Die Genesis des Johan. Evan.' (1892); Ewald, 'Das Hauptproblem der Evangelienfrage' (1890); Halcombe, 'What Think Ye of the Gospels?' (1893). J. S. Riggs,
Auburn Theological Seminary.

Goss, Isham J. M., American eclectic physician and author: b. Oglethorpe County, Ga., 16 Aug. 1819; d. Marietta, Ga., 25 Feb. 1896. He graduated at Emory College, Ga., and in 1844 in medicine from the medical department of the University of Georgia. For fourteen years he followed the practice of the regular or allopathic profession, when he was converted to American Eclecticism and became a leader of that school in the South. Several Eclectic colleges conferred upon him the honorary degree of doctor of medicine. In 1868 he filled the chair of practice in the Philadelphia Medical University and in 1877 the chair of Materia Medica and Therapeutics in the Georgia Eclectic Medical College, reorganized that year. He wrote 'Materia Medica' (1877); and 'Theory and Practice of Medicine' (1882).

Goss, Charles Frederic, American Presbyterian clergyman: b. Meridian, N. Y., 14 June 1852. He was graduated from Hamilton College in 1873, from the Auburn Theological Seminary in 1876, and was at first a home missionary. In 1894 he became pastor of the Avondale Presbyterian Church of Cincinnati. He was also appointed to the chair of Biblical literature in Cincinnati University, and published several volumes, including 'The Optimist,' 'The Philopolist,' and 'The Redemption of David Corson.'

Goss, Warren Lee, American writer: b. Brewster, Mass., 19 Aug. 1838. He studied at the Harvard Law School, served in the Civil War, first in the United States engineers and later in the 2d Massachusetts volunteers; was historian of the National Union of Ex-Prisoners of War. He has been active as editor, magazine-writer, and author of such volumes as 'The Soldier's Story of Captivity at Andersonville' (1866); and 'In the Navy' (1898).

Gosse, gŏs, **Edmund William,** English literary critic and poet: b. London 21 Sept. 1849. He is a son of P. H. Gosse (q.v.). Since 1875 he has been translator to the Board of Trade. In 1884–5 he was engaged on a lecturing tour in the United States. He has made a special study of Scandinavian literature, and has published 'Studies in the Literature of Northern Europe' (1879). Other works of his are: 'Life of Gray' (1882); 'Seventeenth Century Studies: a Contribution to the History of English Poetry' (1883); 'From Shakespeare to Pope: an Inquiry into the Causes of the Rise of Classical Poetry in England' (1885); 'Life of Congreve' (1888); 'History of Eighteenth Century Literature' (1890); 'Life of Philip Henry Gosse, Naturalist' (1890); 'Gossip in a Library' (1891); 'Questions at Issue' (1893);

'The Jacobean Poets' (1894); 'Critical Kit-Kats' (1896); 'History of Modern English Literature' (1897); 'Life and Letters of Dr. Donne' (1899); 'Coventry Patmore' (1904). He has written a romance, 'The Secret of Narcisse' (1892); and several volumes of poems: 'Madrigals, Songs and Sonnets' (1870); 'On Viol and Flute' (1873); 'King Erik,' a tragedy (1876); 'The Unknown Lover,' a drama (1878); 'New Poems' (1879); 'Firdausi in Exile and Other Poems' (1886); 'In Russet and Silver' (1894); 'Collected Poems' (1896).

Gossyp'ium. See COTTON.

Gossypium Phospho, a valuable fertilizer composed of a mixture of cotton-seed meal and pulverized phosphate rock. The making of this fertilizer is an important industry in the South, where one factory has an output of 15,000 tons annually. The phosphate rock, which comes from South Carolina, passes through huge mills of great power, and is ground into a fine powder, after which it is carried through draft pipes to the top of a six-story tower, and there undergoes a process of refinement. The rich yellow meal which comes from the cotton-seed oil-mills is mixed with the ground phosphate, and adds materially to its strength as a fertilizer. The mixture thus obtained is collected into immense bins, and treated with sulphuric acid, assuming a semi-liquid state. It is then called gossypium phospho.

Gotha, Almanach de. See ALMANAC.

Go'tham, a parish of Nottinghamshire, England. The people obtained a reputation for stupidity and simplicity, and the satirical appellation of "the wise men of Gotham," owing to the tradition that King John journeyed through the town for the purpose of selecting a site for a palace, and the inhabitants not wishing to be burdened with the expenses of a royal residence, devised the plan of appearing stupid and foolish during the visit of his majesty. King John left in disgust; whereupon the Gothamites said: "More fools pass through than live in Gotham." The name Gotham is applied also to the city of New York. Thus used it appeared first in 'Salmagundi,' by Washington Irving and James K. Paulding. The authors may have had in mind the worldly wisdom of the city's inhabitants.

Gothenburg (gŏt'ĕn-boorg) **System,** a system of regulating the sale of spirituous liquors which had its origin in 1865, in Gothenburg, Sweden. A company is granted a monopoly of the sale of liquors in the town; managers at fixed salaries are placed in the public-houses, and after paying the expenses, and dividends not exceeding 6 per cent to shareholders (in Norway 5 per cent), the remainder of the profits are placed in the town treasury for the use of the general government and the agricultural society of the province. In Norway the profits, above the 5 per cent to shareholders, go to educational and charitable institutions. The system has been introduced into several towns in Sweden, Norway, and Finland. In the places where the system has been tried the number of drinking places has been lessened, the laws regarding the sale of liquors to minors and confirmed drunkards have been more rigidly observed; but the temptation to increase the revenue has in some places not promoted temperance.

Go'thia, the empire of the Visigoths, or Western Goths, which extended over Spain, and included Septimania, the territory which Theodoric held in Provence; Gaul, and the cities of Carcasonne, Narbonne, and Nimes. These he left to his son Amalarich, who, however, permitted Spain to be under the charge of the Gothic general Theudes, by whom he was eventually murdered. In the reign of Leovogild the kingdom of the Visigoths reached its climax of prosperity. He established his capital at Toledo (569–685) and encouraged art and literature. His sons Reccared and Ermengild were associated with him as co-regents. Ermengild, on becoming a convert to the Nicene faith as professed by Rome, was degraded from all dignity and imprisoned; he was promised his restoration on condition that he renounce the Catholic creed; refusing, he was put to death and was formally canonized in the 16th century by Pope Sixtus V. On the death of Leovogild, Reccared made profession of the Nicene creed, renounced Arianism, and he and his people became more closely amalgamated with the Gallic and Iberian peoples among whom they lived. In the course of the 7th century the Roman Catholic Church reached great power in the Visigothic state and ecclesiastical officials had the preponderating vote in the election of kings. Three sovereigns, Swinthila (620–631), Kindaswinth (641–649), and Wamba (672–680) tried to assert their independence, but each paid for his rashness by the loss of his throne. Witica (701–710) tried to remedy civil and ecclesiastical abuses, but the clergy opposed him, and the Gothic kingdom was already in a condition of deep decadence when the Moors arrived and defeated Roderick, his successor, on the banks of the Guadalete, August 711.

Gothic Architecture. The term Gothic implies barbarous, rude, uncivilized. It was applied by the writers of the 15th and 16th centuries, who, wishing to restore the Greco-Roman art to complete supremacy in Europe, thought to depreciate the style which it would replace. It is a most extraordinary instance of the ready adoption by the admirers of a style of a term first used contemptuously, for the term is in use in most languages in Europe. This is the style which followed the Romanesque architecture of Europe, rising out of it and being, in fact, Romanesque architecture with the addition of vaulting by means of ribs. This constructional change, introduced about 1165 in the royal domain of France, is explained under ARCHITECTURE. The improvement brought with it immense facility in vaulting internal spaces of irregular form; but inasmuch as in this way the whole thrust outward and horizontally was concentrated on a few definitely marked points, it became necessary to develop the buttress system (see BUTTRESS) and to make those masses of masonry very large and wide in the direction of the thrust. So it was that buttresses became what we see them in the choirs and apses of Gothic cathedrals — pieces of carefully built stone wall radiating from a common centre or, at least, forming a right angle with the general exterior wall of the church, their greatest dimension in the direction of the thrust coming from within.

and therefore they are much longer in-and-out than they are wide in the direction parallel to the wall. This, however, is merely the essential construction. Connected with this there arose many surprising changes. Thus the pointed arch, which had been well known in the eastern lands of the Mediterranean, which the crusaders must have seen in Egypt and Syria, and which was not unknown in the Romanesque architecture of France, became now an almost inevitable form, because these ribs of the vault could not be made to take perfectly circular curves across the open space from one point of support to another. They had to be made up of broken curves, that is, of two curves meeting one another at the apex or crown, and in this way the pointed arch would have originated had it not existed before. The Gothic style, however, adopted it as a decorative adjunct, treating all the external openings — windows, doorways and the separate members of arcades — with the pointed arch, and its decided and picturesque character soon affected the whole structure. Even where there was no vaulting, as in a dwelling house with floors of timber made of horizontal beams, window and door openings were still very commonly closed with the pointed arch.

As for the great height of the churches, that originated in the strong desire felt by the builder to get huge windows above the aisle roofs, that is to say, in the walls of the clearstory. The plan of the Gothic church being that of a high middle hall with much lower aisles, it was found that the windows in the walls of those aisles could not illuminate properly the whole interior. Moreover, it became a common practice to build chapels outside of the aisles, so that what had been windows became doorways leading from the aisles into the chapels. The clearstory windows, then, were almost the only light-giving openings, and as, in a moderate-sized church, the aisle would rise perhaps 16 feet to the spring of the vault and 28 feet to the crown or summit of the vaulting, the sloping roof of the aisle would rise at least 10 feet higher still, making a total of 38 feet to the sill of the windows which we wish to build in the clearstory. But those windows having their heads brought down to the shape of the pointed arch because they are crowded on both sides by the vault of the roof, will need to be at least 20 feet high to where their arch begins; so that in the small church which we are imagining here the height of the nave will be at least 130 feet. These would be the proportions of a Gothic church whose nave would be only 30 feet wide. But the great cathedrals had naves about 50 feet wide, and in consequence they would be from 170 to 175 feet high to the crown of the vault; and it may be repeated here that this vast height resulted in the first place from nothing more remote than the desire to get adequate space for windows. Of course in the end rivalry had something to do with it, and there is no doubt that a city starting a new cathedral had some pleasure in thinking that it would be higher and also wider than the churches of neighboring cities. The tendency to great height and to upward pointing masses is none the less a marked feature of Gothic art, and in connection with this the splendid Gothic towers must be considered, for they were always supposed to be roofed with sharply pointed spires. (See TOWER, SPIRE.)

The necessity for the great windows mentioned above was still more evident as stained and painted glass became more splendid in effect and therefore involved a diminution of the daylight which could pass. These colored windows formed one of the special glories of Gothic art, and are, indeed, the most brilliant and also the most original decorative invention of the Middle Ages. (See GLASS.) Another result of the great windows was the window tracery which supported the glass, that is to say, the invention of elaborate patterns wrought in the stone bars which divided up the immense windows. One window in Carlisle Cathedral is 27 feet wide. It is divided by vertical bars of stone into nine separate "lights," and these bars unite at the top of the window to produce an elaborately woven structure of beautiful effect.

Connected with this very surprising and unexampled system of building, the sculpture became surprisingly rich. That of the Romanesque churches had been, especially in France, very rich and varied, with splendid use of vegetable forms in leaf and flower, and a clever and picturesque employment of animal forms treated often in a very grotesque way. This was developed immensely by the Gothic stone-cutters, and by the middle of the 13th century there had taken shape a system of decorative sculpture the most admirably calculated to set off and adorn the structure itself, which the world has ever seen. In comparison with this, Greek architectural sculpture was ill adapted to its purpose as an adornment for magnificent buildings; and unequaled as were the Greek treatment of natural forms and power of design in pure sculpture, their art never undertook seriously the problem of decorating buildings. The Romans, in their sculpture of triumphal arches, set themselves more deliberately to the task of inventing an architectural sculpture, but never approached the variety, the richness and intrinsic interest of that of the 13th century.

Returning now to the structure of a Gothic church, it is to be noted that if we study the cross section of a church we shall see at once how the whole building is conceived. A very high middle hall is vaulted with stone. The vertically acting weight of that stone roof is supported on very slender stone pillars, but the thrust outward, nearly horizontal, is resisted by a strange structure called the flying buttress (q.v.). On either side of that hall is a much lower aisle, also vaulted, and the vault of this lower compartment thrusts inward against the great pillar which carries the high middle vault and also outward against the buttress built to receive it. Now what resists the inward thrust of the aisle vault? Nothing but the enormous weight of the load put upon the pier. This pier, standing between the middle hall and the aisle, would be pushed inward by the thrust of the aisle vault but for this superincumbent pressure; and the whole vertical height of that pillar somewhere from 120 to 180 feet may be relied upon to prevent that dislocation of its lower part, because all disturbing sideway thrust at the top is taken care of by the flying buttress. It is a wonderful structure for absolutely unscientific men to have worked out. It was, as can be shown, a matter of experiment. Engineering was as far as possible from being within the conception of the Gothic builders; for engineering

is the application of mathematical computation to building, and the stone-cutters of the Middle Ages had no algebra, little arithmetic and only a feeble notion of geometry. Mathematics was in its infancy in the 12th century, and we cannot suppose that any of the great builders of that time knew how to compute the thrust or the weight of his building by any calculation whatever.

The history of Gothic architecture may be briefly stated as follows: During the years from 1180 to 1300 it spread all over what is now France; over the British Isles as far as they were civilized and prosperous; over the Low Countries at the north and Spain at the south, where, indeed, French architects were much employed; over the whole Rhine country except that the magnificent round-arched cathedrals of that region caused a certain stand to be made in favor of the original Romanesque; and over the more eastern countries of Europe in so far as Christian church-building was carried on freely. Some beautiful Gothic work was done in Hungary, Bohemia, and the lands on the Baltic. Italy alone received the style from the north with reluctance. The churches built for certain convents and monasteries in the 13th century were indeed completely Gothic of the Burgundian school — buildings as faultless in style as those of the north; but great cathedrals which were wholly out of the control of the conventual orders were built in a curious mixed style which we call "Italian-Gothic" and which needs to be designated by some such compound term. The Italians, with their classical and Greco-Roman affiliation, and the natural love of the southerner for broad, unbroken surfaces and rather dark interiors, would accept neither the huge windows of the true Gothic structure nor yet the system of buttresses and flying buttresses which made the exterior so picturesque, but also so irregular and diversified. They insisted on abundant space for wall paintings, for the putting up of wall tombs and relief sculpture of various forms, and for the decoration of the external walls by mosaic, flat carving in low relief and bands of parti-colored material. In this way there grew up the astonishing cathedral churches of Siena, Orvieto, Monza, Verona, and especially of Florence, and a great number of churches of the second rank, infinitely interesting on account of their beauty of detail, each one serving almost as a museum of lovely works of art, but never satisfactory as logical and complete structures in a coherent style. The style culminated in the great church of S. Petronio, at Bologna, a vast church which was begun about 1300 with the purpose of making it by much the largest church in Italy.

The epoch from about 1400 to 1520 was the time of the flamboyant or florid Gothic. The term flamboyant is properly applied only to the French buildings which have a curious flame-like tracery. In the partial abandonment of the system of ribbed vaulting, the style had lost its main reason for being, for although this was used in many churches, it was also neglected in others, where a solid cut-stone vault was used. The decorative form retained the common influence of the pointed arch, but the sections of moulding, the form of sculpture, the main masses of the building, became very much modified and always in the direction of extreme energy and even excessive picturesqueness. Those were the days of the magnificent towers covered with elaborate pinnacles to the very top, such as Antwerp in Belgium and Strasbourg on the Rhine. Those were the days of splendid porches covered with elaborate sculpture and having very noble statuary included in their adornment. It is a splendid style and lacks only the close coherence of decoration with the structure to receive unbounded admiration. The splendid town houses in the cities in Flanders, Hainault and Brabant form the culminating points of the style in civic architecture. A variety of flamboyant Gothic exists in Spain, which is of astonishing beauty and interest. In England the Tudor style (see TUDOR ARCHITECTURE) increased in popularity through the reigns of Henry VII., Henry VIII. and Elizabeth, and was completed by the introduction of fan-vaulting, the most beautiful architectural invention of the English, and the most original invention of the 16th century.

Gothic architecture disappeared on the complete admission of the classical style imported from Italy. This took place throughout the north of Europe as early as 1520, except in England, where throughout the period which we call Elizabethan and Jacobean there were occasional attempts at building in a mediæval way, usually in connection with previously existing buildings. In England, too, the close of the reign of James I. (1625) found a completely established classical style.

From that time on nothing was done until in the nineteenth century the study given to mediæval buildings was undertaken seriously by archæologists in the single direction of artistic curiosity, and by adherents of one or another Christian church or sect because of a supposed connection between the church and the Gothic style. It was in England that the most decided movement took place. It is known as the Gothic Revival, and has been the subject of much study in illustrated volumes and in the periodicals. As early as 1845 attempts were being made to build in the Gothic way; by 1855 much more was known of the style, and such buildings as the Oxford Museum and St. George's Church at Doncaster were built. Those two buildings represent two opposite types, the church being a faithful reproduction of a bygone style, the museum a new study of that style much recast and reshaped for the new requirements. The most important modern building in the mediæval style was the Westminster Palace or Houses of Parliament. These were, by special act of Parliament, required to be "Gothic or Elizabethan" in character, and the architect, Charles Barry, afterward made a baronet, adopted the latest of all styles that could possibly be called mediæval, that is, the Tudor style. Churches, especially those of the Church of Engand, were and still are almost exclusively built in some form of Gothic; and for thirty-five years, more or less, public buildings also were frequently designed in that way, but this tendency has disappeared. For the result of this movement see ARCHITECTURE. For the use of Gothic architecture in the United States see ARCHITECTURE, AMERICAN.

Bibliography.— Viollet-le-Duc, 'Dictionnaire raisonné de l'Architecture Française' (1854–68); Bloxam, 'Principles of Gothic Architecture' (1882); Rickman's attempt to discriminate the styles of Gothic Architecture (1817; 7th ed.

1881); Britton, 'Antiquities of Great Britain' (1835); Pugin, 'Examples of Gothic Architecture' (1835); Sharpe, 'Architectural Parallels' (1848); Street, 'Brick and Marble of Middle Ages' (1874); and 'Gothic Architecture in Spain' (1869); Ruskin, 'Stones of Venice' (1851-3); Fergusson, 'History of Architecture' (1865-76); Charles H. Moore, 'Development and Character of Gothic Architecture' (second edition, 1889); Russell Sturgis, 'European Architecture, a Historical Study' (1896), Chapters V., VI., VII.; George Gilbert Scott, 'Secular and Domestic Architecture' (1858), and 'Rise and Development of Mediæval Architecture' (1879); Louis Gonse, 'L'Art Gothique'; (1890); Ed. Corroyer, 'L'Architecture Gothique'; Carl F. A. von Lützow, 'Die Meisterwerke der Kirchenbaukunst' (1871); Charles L. Eastlake, 'History of the Gothic Revival' (1872); Louis Courajod, 'Leçons professées a l'Ecole du Louvre' (1887-96).

RUSSELL STURGIS,
Author of 'Dictionary of Architecture.'

Gothic Art. The art of the times and the countries in which Gothic architecture flourished. The term is a misnomer, because even if the architectural style were rightly designated "Gothic," the wall-paintings, metal work, etc., of the time are not properly so described. Still no other term exists for those arts which prevailed in Europe from 1150 to the beginning of the Risorgimento in Italy (about 1375), and in the North until the decided beginning of the Renaissance (about 1500). There are certain arts of decoration which flourished in a wonderful way during this period, while others attained little excellence. Thus the pottery of the north of Europe and even of Italy during the period named, has never attracted much interest in modern times; very few examples of it remain, and what little there is that is effective in an artistic sense is decidedly Oriental (Saracen and Moslem) in character. Glass, too, is of little interest except in connection with windows, and apparently few glass vessels were made during the Middle Ages. On the other hand, metalwork was of singular interest. Bronze was not as common as it has always been in the East and as it was to be in Europe at a later period, but wrought iron reached a splendid development in the gratings, gates, window-bars, etc., of buildings, and in the singular enclosures made for tombs. Brass was cast in large sheets and hammered smooth and then engraved with arms and legends befitting the burial slab of a knight or noble lady; silversmiths' work was carried to a high pitch of excellence, and the common use of colored enamels applied to both bronze and to silver made the ecclesiastical implements and sacred vessels of the time extremely rich. Toward the close of the Middle Ages the complete plate armor of the nobles received a splendid decoration by means of reliefs and embossings, and by gilding in patterns and etching with acid. Very beautiful stuffs were hardly ever woven in Europe during this period; for splendid weaves France, Germany, and England sought the East; but the cloths and linens of the time were good and the common use of embroidery made the costume of the wealthy very splendid. The beauty of the costume, both in color and in form, affected the sculpture of the time; for, as the nude was hardly ever represented, the drapery of the figures became the chief object, with expression of face and gesture, of the architectural sculptors of the day. Both form and color were used freely in the beautiful ivory carvings which were richly painted and gilded.

Sculpture in connection with architecture is treated above. In the semi-architectural conditions of tombs and cenotaphs, life-size statues, usually recumbent, are found as early as the 13th century. These are of marble and other stone; and it is quite well ascertained that great numbers of statues in hammered bronze richly decorated with enamels existed at one time in the churches of western Europe; these also being of life-size for the most part. The raised chest or what seems the sarcophagus, the huge stone box which gives the name of altar-tomb to these monuments, often had its sides pierced with niches, and these occupied by statuettes of religious or symbolical meaning, and often of great beauty. The carvings of decorative objects are of great variety, such as mirror backs and boxes to contain small mirrors, panels of book covers, and statuettes of sacred subjects, sometimes 15 inches or more in height, in addition to elaborate bases upon which they stand.

Painting in the highest sense of the word, that is, the representation of human life and human sentiment, was used with reserve because it had to be applied either to the walls of the church and the palace, or to the vellum pages of a manuscript book. On this account we hardly think of the paintings of the Middle Ages as having led up to that of modern times; we think rather as the origin of modern work of the painting of the 14th century Italians, who themselves derived much of their art directly from Constantinople. Still there was a great skill showing itself in those two ways, and the comparatively few remains which exist in France and Germany of the paintings on walls and vaults during the years before 1500 are worthy to be compared with the splendid miniatures in the manuscripts. These last are not always religious; some manuscripts were of history and poetry and the illustrations given to those books were in keeping with their subject. There had been a great destruction of these splendid manuscripts, but many remain in public and private collections, and modern books have been devoted to their study and to the reproduction of their finest paintings. The special achievement in the art of decoration was in the brilliant windows of the time, but for this subject see GLASS, also GOTHIC ARCHITECTURE and WINDOW.

Bibliography.— De Lasteyrie, 'Etudes sur la Sculpture Française au Moyen Age' (1902); Gonse, 'L'Art Gothique' (1890); Viollet-le-Duc, 'Dictionnaire du Mobilier Français.'

RUSSELL STURGIS,
Author of 'Dictionary of Architecture.'

Gothic Language, the language of the Goths, a member of the Teutonic branch of the Indo-European family. It is known through a Visigothic Bible translation of the 4th century A.D. The earliest historical indications concerning the home of the Goths place them along the lower course of the Vistula in modern Poland and Prussia between Warsaw and Dan-

tzic. Here they remained as late as 150 A.D., but early in the following century, having been dislodged probably by the movements of their Hunnish neighbors, they appeared to the north of the lower Danube and on the northwestern shore of the Black Sea in modern Rumania and southwestern Russia as far east as Odessa. To the west on the Danube were the Visigoths, to the east, in southwestern Russia, the Ostrogoths. In 251 they defeated the Emperor Decius at Philippopolis, but in 270, after various incursions into Thrace and Greece, were driven back to their seat north of the Danube. They were known to the ancient historians and geographers as Gotones or Gothones, and later as Gothi, which points to the native name Gutans, or Gutos.

The only extant monuments of the language are: (1) Portions of a Bible translation, of a paraphrasing interpretation of the Gospel of John, and of a calendar contained in fragments of manuscripts written in Italy in the 6th century, presumably by Ostrogoths. (2) The signatures of Gothic witnesses on two Latin records or receipts, one at Naples, one formerly at Arezzo; the originals of which are now lost. A few Gothic words and names of alphabetic symbols in a Salzburg MS. now at Vienna. (3) A few Gothic words in a Latin epigram, a large number of proper names from Greek and Latin sources, and in old Spanish documents and inscriptions. (4) The scanty records of a Gothic language, probably Ostrogothic, preserved as late as the 16th century in the Crimea. The Bible translation, of which there remain portions of Matthew, Mark, Luke, John, Romans, 1 and 2 Corinthians, Galatians, Ephesians, Philippians, Colossians, 1 and 2 Thessalonians, 1 and 2 Timothy, Titus, Philemon, Esdras, Nehemiah, is associated always with the name Ulfilar or Ulfilas. He was probably himself a Goth, born about 310 A.D., made bishop of the Goths 341, removed 348, with a large body of his followers avoiding persecution, into Mœsia, south of the Danube; died 380 or 381, Ulfilas not only did the work of translation, probably of the entire Bible, but he invented an alphabet for it, using as a basis the Greek uncial alphabet of his time with preservation of its order, as well as of the numerical and phonetic values of the letters. He adapted it, however, to its purpose by the use of forms taken from the Latin and Runic alphabets, creating a system better for the purpose than either of the three.

The inflexion of nouns is distinguished by its relatively close approach to the original Indo-European system. Of the cases it preserves nominative, vocative, genitive, accusative, and dative, the latter including the original instrumental and locative, and to some extent the ablative.

In the remarks that follow we shall take the German and Latin as the bases of comparison. The Gothic article is as follows: *sa*, der; *so*, die; *thata*, das; gen. *this*, des; *thizos*, der; dat. *thamma*, dem; *thizai*, der; accus. *thana*, den; *tho*, die; *thata*, das; pl. masc. *thai*, fem. *thos*, neuter *tho*, die; gen. *thize*, der; dat. *thaim*, den; accus. *thans, thos, tho*, die. There are four cases, nominative, genitive, dative, and accusative; the ablative is only the dative with prepositions. The declensions are as follows: *a*. Strong: *fisks* (Lat. *piscis*, Germ. *Fisch*, fish), *fiskis, fiska, fisk;* pl. *fiskos, fiske, fiskam, fiskans*. *b*. Weak: *hairt-o* (Lat. *cor, cord-is*, Germ. *Herz*, heart), *-ins, -in, -o;* pl. *hairt-ona, -ane, -am, -ona*. Examples of promiscuous cases: *galaubein-as* (Germ. *Glauben-s*); *ahm-an* (Lat. *animum*, Germ. *Athem*); *hand-au* (dat. *Hand*), *-uns* (*Hände*), *-um* (*Händen*); *manag-eim* (dat. pl. *Mengen*); *vastjōs* (Lat. accus. pl. *vestes*); *sunus* (son), *-aus* (Germ. *Sohn-es*), *-au* (*Sohn-e*), pl. *-jus* (*Söhn-e*), etc.—Adjective: *gamain-s* (Germ. *gemein-er*, Lat. *communis*), fem. and neuter, *-a*; comparative degree: masc. *-za*, fem. *-zie*, neuter *-zo;* superlative: *-sts, -sta, -st*. Irregular: *gōda* (good), *batizo* (better), *batists* (best); *ubils, vairsiza* (evil, worse); *mikels, maizo, maizists* (Lat. *magnus, major, maximus*); *leitil, minniza, minnists* (*parvus* [little], *minor, minimus*). The numerals are: 1, *ains, aina, ain;* 2, *tvai, tvos, tva;* 3, *thrins;* 4, *fidvor, fidur;* 5, *fimf;* 6, *saihs;* 7, *sibun;* 8, *ahtau;* 9, *niun;* 10, *taihun, -tig;* 12, *tvalib, tvalif;* 20, *tvaimtig;* 30, *thrinstiguns*, etc.; 80, *ahtautehund;* 100, *hund;* 200, *tvahunda*, etc.; 1,000, *thusund*. Some of the pronouns are: *Ik, thu, is* (fem. *si*, neuter *ita;* Lat. *is, ea, id*); *meina, theina, izes* (*mei, tui, ejus*); *mis, thus, imma* (*mihi, tibi, ei*); *mik, thuk, ina* (Germ. *mich, dich, ihm*); dual. *vit, git* (we two, ye two); gen. *ugkis, igcvis* (of us two, etc.), etc.; *iains, silba, unsar, hveleiks, hvas*, etc. (Germ. *jener, selber, unser, welcher, was*). Examples of verbs: *visan* (Germ. *Wesen*, Lat. *esse*); *im, is, ist, siium, siith, sind*, (*sum, es, est; sumus, estis, sunt*); *vas, vast, vas, vesum, vesuth, vesum* (*fui, fuisti*, etc., Eng. was; future: *siiau, siiis, siiai*, etc.; *vairthan* (Germ. *werden*), *sōkian* (Lat. *sequi*, Germ. *suchen*) etc. The following verb is compared with Sanscrit and Latin: *bair-a* (Sans. *bhārā-mi*, Lat. *fer-o*),*-is* (*-si, -s*), *-ith* (*-ti, -t*); dual. *bair-aus* (Sans. *-ias*), *-ats* (*bhārā-tas*); it has no 3d person (Sans. *bhārē-tam*); pl. *bair-am* (Sans. *bhārā-vas*, Lat. *fer-i-mus*), *-ith* (*bhārā-tha, -tis*), *-und* (*-orti, -unt*); passive or middle: *bair-ada* (Sans. *bhār-ē*, Lat. *fer-or*), *-aza* (*-asē, -eris*), *-ada* (*-atē, -tur*), etc. The following are some of the adverbs, prepositions, and conjunctions: *aiv*, ever; *thar*, there; *her*, here; *iup*, upward; *uta*, outward; *af*, of; *at*, to; *fram*, from, of, for, since; *gau*, if; *inthammei*, whereas, Germ. *indem* (in that), etc.

Gothic Literature, the literature of the Goths, represented chiefly in the version of the Scriptures by Ulfilas, born in Cappadocia about 318, whence he was taken, together with his family, by the Goths, into Mœsia, became their second bishop about 348, and is considered as the translator of almost the whole Bible into Gothic (between 360 and 379). The *Codex Argenteus* (rather *Aureus et Argenteus*), containing a portion of the Gospels, translated by Ulfilas, with capitals of gold foil and the other letters of silver foil, deeply impressed into very fine vellum of a violet color, was made for the use of a Gothic king. It was a part of the plunder taken either by Clovis (507) from Toulouse, after the defeat of Alaric II., or by Childebert from King Amalaric (531). Anton Morillon, secretary to Cardinal Granvelle, found it in the monastery of Werden, near Cologne. Thence it was sent to Prague, and thence to Stockholm by Count Königsmark, after the storming of that city. Vossius, on visiting

Queen Christina, became its possessor (1655), and carried it to Holland, where it was purchased by Pufendorf (1662) for Count M. G. de la Gardie, chancellor of Sweden, who presented it to the University of Upsala (1669), having enclosed it in a silver case. It contained originally 640 pages, only 326 of which were legible in 1670, and a dozen leaves were purloined even of this remnant. Erik Benzel produced a splendid edition of it, and it was subsequently republished by Fr. Junius (Dort 1665), Georg Stiernhielm, from an exact transcript of the original by Derrer, which was burned at Upsala in 1702 (Stockholm 1671), and Edward Lye, from Benzel's edition (Oxford 1750). Johan Ihre, assisted by Sotberg, published a treatise on it, 'Ulphilas Illustratus' (Upsala 1752–5), and 'Fragmenta Versionis Ulphilanæ' (1763), which were reprinted by Dr. A. F. Büsching under the title 'Scripta Versionem Ulphilanam et Linguam Mœso-Gothcam illustrantia' (Berlin 1773). The version of the Bible was probably continued by others after Ulfilas, and the contents of the silver codex itself were revised in Latin versions. Fr. Ant. Knittel found at Wolfenbüttel (1756) a palimpsest with Gothic fragments of the epistle of Paul to the Romans (*Codex Carolinus*). Angelo Mai and Carlo Castiglione discovered at Milan five palimpsests, containing parts of Matthew, the epistles of Paul almost complete, some fragments of Ezra and Nehemiah, of a Gothic calendar, and of a homily. Castiglione edited the fragments of the epistles of St. Paul (1829–39). The epistles to the Hebrews and the Corinthians, the Apocalypse, and the Acts of the Apostles are wanting; but it is not known whether they were ever transalted into Gothic. Gothic signatures of names on documents were found at Naples (in the inscriptions of Donis), of which facsimiles were published by Sierakowsky and Massmann (fol., Vienna 1838). But the 'Gothicon' of Constantine Porphyrogenitus (lays sung at court by circus riders dressed in the garb of Goths, accompanied by the pandura, a sort of lyre), and the inscription on a yard-stick, are not genuine Gothic.

Goths, an ancient Teutonic tribe, whose earliest known home was the shores of the Baltic, between the Vistula and the Oder, where they were living in the 1st century after Christ. Thence they migrated in the 3d century to the regions adjoining the Black Sea. Many other tribes were incorporated with them, and by continual advances and conquests they established, under Ermenric (about 350), the great Gothic kingdom, extending from the Black Sea to the Gulf of Bothnia. This naturally brought the Goths into continual contact, on the west with the western Roman empire, and on the east with the eastern empire as centred at Constantinople. About the year 369 internal commotions produced the division of the great Gothic kingdom into the kingdom of the Ostrogoths (eastern Goths), on the shores of the Black Sea, from the Don to the Dnieper, and the kingdom of the Visigoths (western Goths), from the Dnieper to the Danube. About the year 375 vast multitudes of the Huns and of the Alans, which latter had been subdued by the Huns, poured out of Asia, and drove back the Ostrogoths upon the Visigoths. The Goths obtained permission from the Emperor Valens to settle in Thrace, but were driven to rebellion by the oppression of the imperial governor. In the war which ensued Valens himself was defeated and slain by them at Adrianople in 378. The Emperor Theodosius incorporated the Gothic army into his legions, and henceforth they had an important influence in the affairs of Constantinople. After many vicissitudes the Ostrogoths obtained a settlement in Pannonia and Slavonia, but not till the destruction of the kingdom of the Huns in 453. The Visigoths in process of time obtained a degree of power which excited alarm in Greece and Italy. In 369 Alaric made an irruption into Greece, laid waste the Peloponnesus, and became prefect of Illyria and king of the Visigoths. He invaded Italy about the beginning of the 5th century, and by that measure brought on the destruction of the Roman empire, since Stilicho, the Roman general, could only obtain a victory over Alaric at Verona (in 403) by withdrawing all the Roman troops from the borders of the Rhine. Alaric himself soon returned to Italy, and sacked Rome in 409, and a second time in 410. In 552 the Goths in Italy were finally overthrown in battle and expelled from the peninsula by Narses, general of Justinian. The Visigoths succeeded in establishing a new kingdom in the southern parts of Gaul and Spain, of which, toward the end of the 5th century, Provence, Languedoc, and Catalonia were the principal provinces, and Toulouse the seat of government. The last king, Roderick, died in 711 in battle against the Moors. Since the time of Constantine, Christianity appears to have taken root among the Goths, whence a Gothic bishop is mentioned as present at the Council of Nicæa, 325 A.D. Their form of Christianity was Arian, like that of their protector Valens, and their bishop Ulfilas. The introduction of Christianity among these Goths, and the circumstance of their dwelling near and even among civilized subjects of the Roman empire, greatly contributed to raising them in civilization above the other German tribes. See GOTHIC LANGUAGE; GOTHIC LITERATURE; GOTHIA; OSTROGOTHS; SEPTIMANIA; ULFILAS; VISIGOTHS.

Gottenburg, gŏt'tĕn-boorg, **Gothenburg,** or **Göteborg** (Swedish *Göteborg,* or *Götheborg;* Latin, *Gothoburgum*), Sweden, seaport, the second in the kingdom in respect to population and trade, capital of the county of the same name; situated on the Gota, five miles from its mouth, 255 miles west-southwest of Stockholm. It has a dry dock cut out of the solid rock; and the completion of the Gota canal, and also the railway facilities have greatly increased its commercial importance. Although founded in 1618, by Gustavus Adolphus, the town, in consequence of numerous fires, is quite modern,— the streets are at right angles and the houses well built. The manufactures include iron, steel, machinery, sail-cloth, linen, and leather, and there are oil-presses, cotton-mills, dye-works, and building-yards, at which a considerable number of vessels are launched; the most important industrial establishments are tobacco factories, porter breweries, and sugar-refineries. The trade is very extensive, the harbor being excellent and generally free from ice. Its commercial importance dates from the Continental blockade

of 1806, when it became the chief British depot in northern Europe. The chief exports are iron and steel, copper, wood, tar, linseed, bark, bones, juniper berries, cranberries, and manufactured articles; the chief imports grain, sugar, coffee, tea, wine, salt, seal-oil, cotton yarn, and twist. Among social reforms the town is noted for its licensing system (see GOTHENBURG SYSTEM). Pop. (1897) 117,103.

Götterdämmerung, gėt″tėr-dĕm′mĕ-roong, "the twilight, or gathering nightfall of the gods," the title of Wagner's closing opera in his Nibelungen cycle of dramas. The subject of the opera is what is called in Scandinavian mythology the *Ragnarok*, or end of the world. This was brought about largely by the admission of Loke, the god of evil and mischief, into Asgard, the abode of the gods. It was through Loke that Balder, the bright and good god, was slain and flung down into the abodes of Hel, the goddess of death. Confusion throughout the universe is the consequence. The sun and moon are swallowed by giants; continuous winters rage without an intervening summer; the earth trembles in the throes of earthquakes. Mountains topple down with a crash; the Fenriswolf breaks its chains and fetters. The Midgard serpent writhes to get free; the ship Naglfar, built of the finger-nails of dead men, passes over the sea, filled with giants of the frost and mountain; Loke leads the hosts of Hel and bursts upon the scene. The powers of evil rush to the battlefield Vigrid, while Heimdal blows his Gjallarhorn, Odin seeks the giants for advice, the other gods as well as the heroes of Valhal arm themselves and sally forth, and the battle begins. While the fight is still raging the immortal god Surt flings light and flame over the world, and the earth, reduced to ashes, sinks beneath the watery waste. See NIBELUNGENLIED; RAGAROK; and SCANDINAVIAN MYTHOLOGY.

Gottfried (gŏt′frēd) **of Strasburg**, German poet: probably b. Strasburg about 1200. He was not, like most of the Minnesingers (minstrels) of his age, a noble. Besides many lays, he was the author of the great chivalric poem, 'Tristan und Isolde,' derived from a Welsh original, but possessing as much originality of character as any other German classical work. For grace, elegance, and vivacity of description, richness of coloring, and melody of versification, this work stands alone in old German literature.

Gottheil, gŏt′hīl, **Gustav**, American rabbi: b. Pinne, Posen, 28 May 1827; d. New York 15 April 1903. Following in his boyhood the studies prescribed for Jewish youth, he was fortunate in broadening his education at the universities of Berlin and Bonn. In 1855 he was elected assistant rabbi at the Berlin Reform Temple, thus early showing his progressive tendencies. In 1861 he received a call to the Congregation of British Jews, Manchester, England, where he spent 13 years of effective work. In 1873 he was invited to the Temple Emanu El, of New York, first as assistant to Rev. Dr. Samuel Adler, and then, on the latter's retirement, as sole rabbi. In his new field his activity rapidly developed along the lines of education and benevolence. Under his personal impetus the Emanu El Preparatory School and the Jewish Ministers' Association were founded, and continued for some years. He organized the Emanu El Sisterhood of Personal Service, which, adopted by many other Congregations, has become a successful feature of communal benevolence. His voice and pen were largely enlisted in behalf of Judaism and the liberal movement, and he was often heard in Christian churches, while Christian clergymen occasionally occupied his pulpit. A favorite speaker at public gatherings, his enthusiasm, sympathy, and broad culture did much to win recognition for his co-religionists. In his last years he was an ardent champion of Dr. Herzel's movement to secure a place of shelter for persecuted Jews, the latest development of the Zionistic idea. Apart from contributions to a few magazines and reviews, his published works were a hymn book and 'Sun and Shield,' a book of daily devotion, in both of which he drew largely from non-Jewish sources.

Gottheil, Richard James Horatio, American Semitic scholar: b. Manchester, England, 13 Oct. 1862. He was graduated from Columbia in 1881, studied also at Berlin, Tübingen, and Leipsic, and became professor of Semitic languages in Columbia, director of the Oriental section of the New York public library, and (1898) president of the American Federation of Zionists, of whose principles he is an active exponent. He is also a member of the central committee of the general organization. He became an editor of the 'Jewish Encyclopædia' in 1901, and published 'The Syriac Grammar of Mar Elia of Zobha' (1887). He is a son of G. Gottheil (q.v.).

Göttingen, gėt′tĭng-ĕn, Germany, town in the Prussian province of Hanover, in the valley of the Leine, 59 miles south-southeast of Hanover. It is a place of great antiquity, and was once famous for its fortifications. It contains a noted university, founded in 1734. Göttingen belonged to the Hanseatic League and enjoyed great prosperity until the Thirty Years' War. The manufactures consist chiefly of a few woolen tissues, tobacco, leather, paper, books, and philosophical instruments. Pop. 30,293.

Göttingen, University of, or **Georg-August University**, a German institution, was founded by George II. of England, known also as Georg August, elector of Hanover. The plan of the school was outlined as early as 1732, was established in 1734, and opened in 1737. Its popularity decreased after the expulsion of the seven professors: Albrecht, Dahlmann, Ewald, Gervinus, the two Grimms, and Weber, for political reasons, but it has recovered itself since 1866, and in 1901–2–3 it had an average attendance of over 1,000 students, and several eminent names among its professors. The principal building, to which William IV. of England contributed £3,000, was completed in 1837. Connected with the university are a museum with extensive and valuable collections, an observatory, a well-equipped school of anatomy, botanical gardens, and a library of about 500,000 printed volumes and nearly 6,000 manuscripts. It has also a pedagogical seminary, a gymnasium which dates from the 16th century, a museum, an art gallery of German and Flemish pictures. Consult: Pütter, Saalfield.

and Oesterley, 'Die Georg-August Universitat.'

Gottschalk, gŏt'shälk, **Louis Moreau,** American pianist and composer: b. New Orleans, La., 8 May 1829; d. Rio de Janeiro, Brazil, 18 Dec. 1869. He studied in Paris and after his return to the United States in 1853 became the most popular pianist in America. His playing was confined to his own compositions. He traveled extensively in Mexico, the West Indies, and South America, and was taken fatally ill, while playing at Rio Janeiro his latest work, 'La Morte.'

Götz von Berlichingen. See BERLICHINGEN, GÖTZ VON.

Gough, gŏf, **John Bartholomew,** American temperance lecturer: b. Sandgate, Kent, England, 22 Aug. 1817; d. Frankford, Pa., 18 Feb. 1886. He came to America in 1829 and two years later became a bookbinder in New York. Falling into dissipation, he lost regular employment and was reduced to giving recitations and singing comic songs at low grog shops. In 1842 he was induced to attend a temperance meeting and take the pledge; and he then made up his mind not only to reform, but to influence others to do likewise. Save for a short relapse, a few months later, his pledge was kept, and ere long, as a temperance lecturer, he became one of the most popular of public speakers in America and England, which he visited on temperance tours 1853–5, 1857–60, and 1878. In later life he handled literary and social topics, as well as temperance themes in his lectures. He published an 'Autobiography' (1846; enlarged 1870); 'Orations' (1854); 'Temperance Lectures' (1879); 'Sunlight and Shadow, or Gleanings from My Life Work' (1880).

Goujon, Jean, zhŏñ goo-zhôñ, French sculptor and architect: b. Paris 1515; d. about 1570. He was employed with Pierre Lescot, architect of the Louvre, on the restorations of St. Germain l'Auxerrois, 1542–4; and after the accession of Henry II., decorated the Chateau d' Anet for the king and Diana of Poitiers. To him is ascribed what is considered the masterpiece of French sculpture, the 'Huntress Diana,' now in the Louvre collection, and the fountain of the Innocents at Paris was also his work.

Gould, goold, **Augustus Addison,** American zoologist: b. New Ipswich, N. H., 23 April 1805; d. Boston 15 Dec. 1866. He was graduated at Harvard 1825, and in 1856 became visiting physician to the Massachusetts General Hospital. His strong scientific tastes led him to take up investigations in botany, zoology, and conchology, and in the latter branch he became one of the most eminent authorities in the whole world. He published 'System of Natural History' (1833); 'Invertebrate Animals of Massachusetts' (1841); 'Otia Conchologica' (1863); 'Principles of Zoology' with Agassiz (1848).

Gould, Benjamin Apthorp, American astronomer: b. Boston, Mass., 27 Sept. 1824; d. Cambridge, Mass., 26 Nov. 1896. He was graduated at Harvard in 1844 and pursued the scientific study of astronomy at several foreign observatories, returning to America in 1848. In 1851 he assumed charge of the longitude department of the United States Coast Survey, and perfected methods for determining the longitudes telegraphically. By 1866, 20 longitudes in the United States had thus been determined. He was director of the national observatory at Cordova, Argentina, 1870–85, and there completed three extensive star catalogues, and conducted meteorological and climatological investigations. He was the founder and editor of the 'Astronomical Journal' (1849–61), and published 'On the Trans-Atlantic Longitude, as Determined by the Coast Survey' (1869); 'Uranometria Argentina' (1879); etc.

Gould, Elgin Ralston Lovell, American economist: b. Oshawa, Ontario, Canada, 15 Aug. 1860. He was graduated from Victoria University, was fellow (1882–4) and lecturer (1892–7) at the Johns Hopkins University, and professor in the University of Chicago (1895–6). In 1896 he became president of the City and Suburban Homes Company of New York, and at one time vice-president of the American Economic Association. He has written: 'The Housing of Working People'; 'Popular Control of the Liquor Traffic'; 'The Gothenburg System of Liquor Traffic'; 'The Social Condition of Labor.'

Gould, George Jay, American capitalist: b. New York 1858. He was the eldest son of Jay Gould (q.v.). In financial circles he was active chiefly in connection with his large railway interests, particularly as president, from 1888, of the Little Rock & Fort Smith Railroad, from 1892 of the Manhattan Elevated Railroad of New York, and from 1893 of the Saint Louis, Iron Mountain & Southern; the International & Great Northern; and the Missouri Pacific.

Gould, Hannah Flagg, American poet: b. Lancaster, Mass., 1789; d. Newburyport, Mass., 5 Sept. 1865. She was an aunt of B. A. Gould (q.v.), and at one time very popular as a verse writer. She published: 'Hymns and Poems for Children' (1854); 'The Golden Vase'; 'The Youth's Coronal' (1850); 'The Mother's Dream' (1853); etc. 'The Snow-Flake' and 'The Frost' are still remembered and quoted among her poems.

Gould, Helen Miller, American philanthropist: b. New York 20 June 1868. She is a daughter of Jay Gould (q.v.), and has achieved an extended fame through her benefactions for charitable and educational uses. At the opening of the war with Spain she not only contributed $100,000 to the United States government, but was active in the Woman's National War Relief Association, to which she was a generous contributor. Among other notable gifts of hers are that of $380,000 to New York University, etc., in 1898; $50,000 to the naval branch of the Young Men's Christian Association of Brooklyn; and $100,000 to New York University for a Hall of Fame for Great Americans, in 1900.

Gould, Jay, American financier: b. Roxbury, N. Y., 27 May 1836; d. New York 2 Dec. 1892. He was brought up to labor on his father's farm; and was for a short time a student at Hobart College. Here he learned surveying. After making surveys of Ulster, Albany and Delaware counties, he began his railroad career. This was directly after the panic of 1857. His first speculation was the purchase of

the bonds of the Rutland & Washington Railroad. He himself became president, treasurer, and superintendent of the road. Soon afterward he effected a consolidation of his road with the Rensselaer & Saratoga line, withdrew his capital, removed to New York, opened a broker's office, and began dealing in Erie stocks and bonds. His aim was to gain control of the Erie. This he did by depressing the value of the stock and then buying it in. In association with James Fisk, Jr., he entered the directory of the company, was elected president, while Fisk became vice-president and treasurer. On the reorganization of the company, 1872, he lost official connection with it. He then invested in the Pacific railroads, secured control of several lines, built branches, and effected combinations which resulted in the establishment of what is known as the "Gould system." Jay Gould and his partner, Fisk, were the cause of the financial crisis and panic known as "Black Friday" (q.v.). They cornered all the gold in New York, $15,000,000, and caused numerous failures, netting themselves $11,000,000.

Gould, John, English naturalist: b. Lyme, Dorsetshire, 14 Sept. 1804; d. London 3 Feb. 1881. His reputation as a taxidermist procured him the post of curator to the Museum of the Royal Zoological Society in 1827, and in 1832 he published 'A Century of Birds from the Himalayan Mountains.' He next undertook a work of much more extensive character, entitled the 'Birds of Europe,' published 1832–7. This was followed by: 'Birds of Australia' 1842–8; 'Mammals of Australia' (1859); 'Monograph of the Trochilidæ, or Family of Humming Birds' (1850); 'Monograph of the Odontophorinæ, or Partridges of America'; etc.

Gould, Sabine Baring. See BARING GOULD, SABINE.

Gould, Thomas R., American sculptor: b. Boston 1818; d. 1881. He was a pupil of Seth Cheney, of Boston, and there established his first studio. From 1868 he was in Florence, Italy. His works include a statue of Hancock in the Lexington town-hall; portrait-busts of Junius Brutus Booth, Emerson, and Gov. John A. Andrew; and the ideal statues 'The West Wind,' 'Christ,' and 'Satan.'

Gounod, Charles François, shärl frän-swä goo-nō, French composer: b. Paris 17 June 1818; d. St. Cloud 18 Oct. 1893. He began his studies in the Paris Conservatory under Halévy, Le Sueur, and Paer, and carried the Rome prize with his cantata 'Fernando' in 1849. While in Rome he made Italian Church music his chief study. His mass in the style of Palestrina, which he composed in Vienna in 1843 after his return from Rome, was the first fruits of this study. On arriving at Paris he took charge of the music in the church of the Missions Etrangères, and produced no original work until April 1851, when his first opera, 'Sappho,' appeared. Gounod's next production was the five-act opera, 'The Bleeding Nun ('La Nonne sanglante') (1854). Following this was the comic opera founded on Molière's 'Le Médecin malgré lui' (1858), and the grand opera 'Faust et Marguerite,' which latter was a signal success and was produced with much enthusiasm in all the more important opera houses of Europe. Even in Germany, the home of the Faust legend in music and poetry, the originality, and wealth of melody of Gounod's music, together with his powerful orchestration were so manifest above all else in the opera, that his Faust became a favorite with the public. Later operas of his were: 'Philémon et Baucis' (1860), which was not popular; 'La Reine de Saba' (1862); 'Mireille' (1864); 'Roméo et Juliette' (1867), which was favorably received in every opera house of Germany; 'Polyeucte' (after Corneille's drama), which was a failure; finally the comic opera, 'Cinq Mars' (1877), and the last of his grand operas, 'Le Tribut of Zamora,' which was well received. Besides these operatic compositions he wrote much religious music, notably the 'Rédemption,' which was performed in England and later in Germany, and has been very popular in the United States. He also produced at Brussels his 'Mors et Vita,' and in addition wrote cantatas, symphonies, pieces for the piano and numerous songs. During the Franco-Prussian war (1870–1) he resided in England, where he formed the Gounod Choir, a chorus of mixed voices, whose concerts were widely popular. Consult: Claretie, 'Portraits Contemporains' (1875); Voss, 'Ein Lebensbild' (1895); Paguerre, 'Charles Gounod, sa vie et ses œuvres' (1890); Boret, 'Charles Gounod, His Life and His Works' (1890).

Goupil, Jules Adolphe, zhül ä-dōlf goo-pēl, French painter: b. Paris 7 May 1839; d. Neuilly 30 April 1883. He was a pupil in the studio of Ary Scheffer and achieved success by his powers as a portrait and genre painter. His most famous picture, 'Mme. Roland's Last Day in Prison,' is in the Luxembourg. His father, Adolph Goupil, did much to encourage the introduction of French art into this country; well known throughout Europe as a Parisian picture dealer, he opened a branch house in New York.

Goura, gow'rạ, any one of a group of large, handsomely dressed pigeons of New Guinea, constituting the genus *Goura,* and distinguished by their fan-like crests, — the crowned pigeons. These birds are found near open or cultivated lands, ranging near the ground in small flocks, and feeding on buds, seeds, berries, and other fruits, and on worms, snails, and insects. In addition to the cooing heard in the nuptial season, they utter harsh, trumpet-like cries. During the heat of the day, or when alarmed, they hide in the thickest jungle. They make rude nests and lay only one white egg. The best-known species (*G. coronatus*) is a beautiful bird over two feet in total length. It is sometimes kept among poultry, and its flesh is much esteemed.

Gourami, goo'rạ-mĭ. See GORAMY.

Gourd, gōrd or goord, a plant of the genus *Cucurbita* or its fruit. In Europe the name is given generally to pumpkins, squashes, melons, etc.; but in America is restricted to those with hard-skinned, thin-fleshed inedible fruits, cultivated for ornament or because their excavated shells are useful as dippers, etc. See CALABASH GOURD; CUCURBITACEÆ.

The Hebrew word translated gourd in Scripture is apparently so much akin to the Greek word *kiki,* used by Dioscorides for the castor-

oil plant (*Ricinus communis*), that the "gourd" of Scripture was probably that species. It is a euphorbiaceous plant. The wild gourd of Scripture is a plant which grew on a wild vine — that is, was procumbent, and had tendrils. It moreover produced "death in the pot"; discoverable in a moment by the taste. It was probably either the colocynth (*Citrullus colocynthis*), or the squirting cucumber (*Momordica elaterium*).

Gourd-seed. A fish. See BLACKHORSE.

Gourd-worm, the fluke-worm (q.v.) which affects the livers of sheep.

Gourgand, Gaspard, BARON DE, French general: b. Versailles 14 Sept. 1783; d. 25 July 1852. Entering the army as lieutenant of artillery in 1802, he distinguished himself in several important battles, and in the battle of Brienne saved Napoleon's life from the Cossacks. He subsequently became Napoleon's adjutant, and as his confidential secretary accompanied him to St. Helena, but for various political reasons left him in 1818. He was subsequently aid-de-camp to Louis Philippe, and became a member of the House of Peers in 1841. In the previous year he was made one of the commission appointed to bring the remains of Napoleon from St. Helena to France. He was passionately devoted to Napoleon and unreasonably jealous of those who attended upon the emperor in his exile. He assisted Napoleon in writing his 'Mèmoires' and was the author of 'La campagne de 1815'; 'Mèmoires pour servir a l'histoire de France sous Napoleon' (1822–3); 'Réputation de la vie de Napoleon par Sir Walter Scott' (1827); and a remarkable journal kept during his stay at St. Helena, but which remained in MSS. till 1898. An English translation of selections from the journal by Mrs. Elizabeth Latimer (q.v.) appeared in 1903. The work is exceedingly prolix, but of great value, since it records with the minuteness of Pepys, or the precision of Boswell, the incidents of daily life and the conversations of the fallen emperor. In no other work can the personal side of Napoleon be so well studied as in Gourgaud's journal. An entire chapter is given to the emperor's criticisms on his own action at Waterloo, and of equal interest are his judgments concerning other great commanders from Cæsar's times to his own. His opinions regarding English character are essentially French in their character, and amusing from their entire misconception of it. But in this journal we are shown Napoleon's conversation on almost every conceivable subject, insignificant or important, and always with the frankest egotism.

Gourgues, Dominique de, dō-mē-nēk dė goorg, French soldier and adventurer: b. Mont-de-Marsan 1530; d. 1593. Captured by the Spaniards in Italy, where he was serving in the army of Maréchal de Strozzi (1557), he was condemned to the galleys and in 1559 his ship was taken by the Turks; the Turkish ship in turn fell into the hands of the Knights of Malta, who set him at liberty. After many voyages to Africa and South America he signalized his name by taking vengeance on the Spaniards of Fort San Mateo, who under Menendez had massacred the Huguenots of Fort Caroline, Florida. He razed Fort Mateo and killed in battle or hanged every Spaniard he found there.

Gourney, SIR **Goldworthy,** English inventor: b. Treator, England, 14 Feb. 1793; d. Reeds, England, 28 Feb. 1875. His early studies were in medicine, but he subsequently devoted himself to chemistry. Among important inventions by him are the oxyhydrogen blowpipe, lime-magnesium and oil-gas lights, the high-pressure steam jet, the tubular boiler, and steam carriage. He was knighted in 1863.

Gout, a disease of comparative infrequency, affecting for the most part the large joints of the foot or knee, and accompanied by a deposition in the joints of a salt of uric acid, notably sodium urate. It is a disease that has been observed for many centuries, and many of the older classical writers have left descriptions, jibes, and witticisms concerning it. Notwithstanding an immense amount of study of the many factors concerned with gout it remains true that the real essential causes of the disease are unknown. Gout is found throughout civilized communities, but it is no respecter of persons, alike affecting the rich and the poor, although it is more prevalent among the former. Whether the afflicted are the "fag-ends" of previously well-to-do families is unknown. Gout is thought to be much more common in England and in Germany than it is in the United States, and the few statistics available, while notoriously unreliable, seem to bear out this belief. Some observers believe that the disease is becoming more frequent in the United States. On this point, however, there are almost no reliable figures. It is a disease of middle years, and men are more often attacked than women.

The symptoms of gout may be grouped under three general heads, acute gout, chronic gout, and irregular gout. In acute gout there may be premonitory twinges of pain in the small joints of the hand or foot. These may be accompanied by dyspepsia, restlessness, and irritability. The urine is usually diminished in amount, is dark in color, and strong in odor. On cooling, a greater deposit of brick-dust urates occurs than is usual. This brick-dust sediment, it should be borne in mind, occurs in practically all healthy urine when cooled. It is not a sign of disease, and quacks would starve if the people did not believe their "brick-dust" horrors. The gout attack frequently commences in the middle of the night, or about 4 A.M., when the temperature of the body is nearly at its lowest point. There is excruciating pain in some one of the joints of the body, usually of the big toe. The pain is accompanied by swelling, redness, and stiffness of the joint, and there may be some constitutional disturbance with a rise of temperature to 102° and 103° F. The symptoms may slowly subside during the day, to recur with equal or diminished severity at a 24-hour interval. After 3, 4, or 6 days the swelling and pain gradually grow less, and in 8 or 10 days the patient may be well. Other joints may be involved, and the attack may last only a few days or may persist for two weeks or more. Occasionally there are accompanying gastro-intestinal disturbances, with nausea, vomiting, diarrhœa, dyspnœa, and heart-depression. If an acute attack is followed by other attacks, a condition of chronic gout develops. The joints become sore and remain swollen, and a larger number of joints become involved in the reaction. The joints no longer lose their swollen

appearance, since deposits of urates take place in the cartilages and in the ligaments, but become further enlarged and distorted. These local collections of urates are termed tophi, and they may be found in other joints — in the hands, knees, elbows, and even in the ear-cartilages. The frequent attacks of pain leave the patient much more irritable. He is apt to be dyspeptic, sallow-faced, and to show signs of disease in his heart and blood vessels. Under the term irregular gout have been grouped a veritable scrap-basket assortment of symptoms which different clinicians have thought were undeveloped cases of gout. By many authorities these irregular forms of so-called "gouty diathesis" are taken "with a grain of salt"; yet there is little doubt that a number of more or less definite symptoms are found in those who are moderately gouty which may be attributed to this disease. These irregular forms are frequent in gouty families and include certain forms of chronic eczema, attacks of biliousness with marked constipation, etc. Frequently there is a condition of arteriosclerosis (q.v.) with tendency to the development of slight dropsy or other symptoms of disease of the heart or kidneys. Nervous headaches or migraine may be another heritage, although migraine is such a common disturbance that its presence proves little for any of the many one-sided theories concerning it. Itching feet, hands, or eyeballs, irritable bladder with small quantities of acid, high-colored urine, are other symptoms attributed to irregular gout. Occasionally severe forms of eye-disease occur in those thought to be gouty, to account for which no other cause seems probable.

The cause of gout is really unknown. The theories are as numerous as the sands of the sea. A bad heredity is one of the most important factors, since from 50 to 60 per cent of gouty patients have had it left to them by their ancestors, one or two generations back. The boys seem more prone to this influence than the girls. Advancing age plays some part, the disease usually setting in before 50 years and generally after 40, although in the markedly hereditary forms the disease may come on much earlier, especially in the irregular manifestations. Alcohol is perhaps the most important contributory factor, those indulging in large quantities of fermented liquors seeming to be much more liable to contract the disease. Among the poor it is chiefly in the ale and beer drinkers that the disease is found. Overeating, lack of exercise, and minor injuries to the feet are also important causes of the development of gout. As for the general theories to account for the poisoning — for it seems like a poisoning — all at best are pure hypotheses. Uric acid is considered by many as the chief criminal, but beyond the fact that there is an increased amount of uric acid found in the urine during an attack, and deposits of a salt of uric acid in the joints, there is no proof of its causative influence. Many modern students believe this to be a purely secondary condition, and not a primary one. There is a marked increase in the metabolism of nucleoproteids (q.v.) which in large measure accounts for the increase in one of its products of oxidation, uric acid. Clifford Allbutt has well summed it up when he writes that we are far from sure that gout may not be due to some extrinsic element. The peculiar geography of gout is in need of careful inquiry; the effects of microbic infection of the kidney are unknown in their relation to the precipitation of uric acid. Again, some internal secretion may be at fault, as in diabetes. "Till we know then whether gout is a mere shortcoming in ordinary metabolism, or a peculiar perversion of it, or a static susceptibility of fibrous tissue, or a defect of some enzyme, or a perturbation of the nervous system, or again some factor from without, it appears we must confine the name of gout to the uratic precipitations which are known, and which can serve as a touchstone, and as to all other vague 'acidities,' 'flatulencies,' 'megrims,' and 'biliousness' of whatever occult kind, be content to treat them empirically, awaiting the results of the analysis of our nutritive life upon which biochemistry is actively and hopefully engaged." Summing up what is really known about the pathology of the disease, it seems established (1) that gout is a morbid condition, of which the most striking phenomena are acute attacks of arthritis (q.v.), which tend to recur and are accompanied by redness, pain, and œdema of the part; (2) that the affected joints are found to be the seat of a deposit of urate of sodium, which occurs first in the articular cartilages and afterward infiltrates all the surrounding structures; (3) that deposits of this material may also be found in other parts, such as the pinna of the ear, the bursæ, etc.; (4) that excess of uratic material may be demonstrated in the blood of a gouty patient, the amount being greatest before an acute attack, and least immediately after one; (5) that the influence of heredity in producing gout is undoubted; and that certain poisons, such as lead and malt liquors, may induce an attack. In the same manner our ignorance concerning the cause of gout may be summed up by saying (1) that it is not known how the excess of uratic matter is brought about, whether it is due to an increased intake with the food, to increased formation in the body, or to deficient elimination by the excretory organs; (2) that it is not known whether the uratic excess is the cause of the phenomena of the disease or is a mere casual accompaniment of the perverted state of nutrition; (3) that it is not known in the case of arthritic attacks whether the deposit of urate of soda is the cause or the effect of the local inflammation; in other words, that gout is a disease the cause of which is not yet understood.

The treatment, however, is on better foundations. Here empiricism has taught the general rule that most people eat and drink too much and that temperance in all things is beneficial in gout as in other experiences in life.

Treatment.— No routine line can be laid down that can be adapted suitably to all cases. Individualism — the treatment of the patient, rather than the disease — is the prime feature. The treatment for gout should include (1) the medicinal treatment of the gouty paroxysm, in acute gout; (2) the medicinal and dietetic treatment of the sub-acute and chronic conditions, and (3) the treatment of the affected joints, with the object of removing, if possible, the foreign deposits.

The horizontal or slightly elevated position for the limb, with a cradle to take off the weight of the bed-clothes, warm packs, soothing lotions such as the lead and opium wash, and an oil-silk

covering constitute the main features in the local treatment of an acute attack. Internally, colchicum, in dosage to be determined by the physician, is the best remedy. A brisk cathartic aids the action of the colchicum, and a mild diuretic may be combined to advantage — citrate of potash, cider, lemonade, being reliable. The pain and insomnia should be controlled by the visiting practitioner. Opium in all its forms is to be avoided. In the treatment of chronic gout attention must be paid to diet. Malt liquors are to be avoided, and the heavy wines, such as port and burgundy. There is no good reason why any particular form of food should be eliminated, but it is paramount that simplicity and undereating rather than overeating should be the rule. The so-called uric acid theory of gout is a pathological hobgoblin. Copious drinking of alkaline waters is of value — largely because of the water. Potassium salts seem to be of service. A bracing air, low humidity, absence of cold east winds, constitute the chief climatic conditions to be sought.

Smith Ely Jelliffe,
Editor 'Journal of Mental and Nervous Diseases.'

Goutweed, or **Goutwort,** a species of wild carrot (*Ægopodium podagraria*) introduced from Europe, where in England it is known as masterwort, herb-gerard, and now a weed in waste places along the Atlantic coast.

Gouverneur, goo'vėr-nėr, N. Y., village in St. Lawrence County; on the Oswegatchie River, the Rome & W. R.R.; about 40 miles south of Ogdensburg. It has large marble works; the talc mines nearby are well developed, and considerable iron ore is mined, and wood-pulp is manufactured. It is in a good agricultural region. Pop. 3,700.

Government is the term used to describe the mechanism or *ensemble* of agencies through which a body-politic formulates and executes its will.

Governments de facto and de jure.— Since they act only as the agents of the sovereign political power, governmental agents in order legally to exercise the functions of their offices, are obliged to possess a delegation of powers from the state they represent. In case they are not able to produce a sufficient evidence of this authorization, their acts are *ultra vires,* and as such of no legal force, and they themselves are subject to civil or criminal suit at the instance of parties whose persons or property they may have injured by their acts.

It not infrequently happens, however, that persons claiming political authority, while able to produce satisfactory evidence of their official status and competence, do so by referring to grants of power from a political sovereignty, the legitimacy of which is not admitted by the parties over whom their authority is attempted to be exercised. It thus becomes necessary to distinguish between governments *de facto* (*sed non de jure*) and governments *de jure.*

The terms *de facto* and *de jure* are applicable to governments in a purely relative sense. That is to say, which of the two is properly descriptive of a given political organization depends upon the point of view of those who characterize it. Thus a government is *de jure* as well as *de facto* when it has been established by, claims to represent, and is in fact guided by the will of a state the legitimacy of which is recognized by the individuals over whom its control is extended. It is *de facto* but not *de jure* to any particular individual when, though actually in existence and able to exercise a certain amount of power, its legal character is denied by that individual. Thus in the case of an attempted revolution; from the standpoint of those who have repudiated their allegiance to the old state, refuse obedience to its government, and have organized for themselves a new political machinery, the old government has but an actual and not a legal existence, the new government being the only one in their eyes possessing a legal basis. Upon the other hand, from the point of view of those who still support the old state, the newly established government has but a *de facto* existence, the old government being conceived as the one legal organization. Thus, during the American Civil War, the existence of the southern Confederacy as a state was never recognized by the United States nor by foreign powers. The existence of a *de facto* Confederate government was, however, admitted, and its soldiers recognized as belligerents. The continued allegiance of its supporters to the United States was, however, always asserted by the United States, and no legal force of any sort was ever ascribed, then, or after the end of the war, to any of its acts. No formal treaty of peace was entered into with the southern Confederacy, the surrender of its armies being received simply as military acts, and its government permitted to go out of actual existence without any formal act to mark its demise.

The Ethical Right of Governments to Exist. — The concrete question as to the moral right of a particular government to exist and to coerce individuals, is often confused with the abstract one as to the moral justification for the existence of political restraint in general. These two questions are, however, quite distinct, and are to be answered upon quite different principles. So long as men's interests conflict, or, at least, so long as they are conceived by them to conflict, coercion of some sort must result, for the desires of all, under such circumstances, cannot be satisfied. Some will have to give way to others, or all yield in part. The force bringing about the final settlement may be individual, social, political, or religious, but in any case restraint is applied and the freedom of action of the individuals concerned correspondingly interfered with. This being so, it is clear that the question as to the ethical legitimacy of coercion by the state is not to be answered by viewing such coercion as a restraint upon individuals who otherwise would possess entire freedom of action. Rather it is to be viewed as a control of individuals who, but for the existence of political government and law, would be subject to the compulsion of other forces. In other words, so long as men's desires conflict there cannot properly be raised the abstract question as to the rightfulness of restraint humanly imposed, or even the question as to its proper amount. The conflict of desires makes coercion inevitable, and the extent of this conflict fixes its amount. The only questions, therefore, that rightfully may be raised are as to the form that the compulsion shall assume, and the general principles that

shall guide it. The justification, then, for the existence of any particular political authority, if justification there be, consists in the fact that it furnishes a more intelligent, more beneficial, more just, and less painful form of restraint than that which, in its absence, any other force or forces would supply. A state and its government is but an instrument humanly devised for a people's good. It, therefore, has to be justified by its works. There is, thus, no theoretical difficulty in conceiving of a political authority so corruptly and oppressively administered as to cause evils overbalancing those that it prevents. In such a case, it has no ethical right to be. Practically speaking, however, there can be no question but that so grievous are the inevitable evils of lawlessness and anarchy that it is difficult to picture to oneself a political régime so evil in its effects as to render preferable to it a complete absence of political order.

To repeat, then, for the question so often stated in the abstract form as that of the right of the state to be, should be substituted that as to the right of its government to be and to exercise the functions that it does and to exercise them in the manner that it does. As the author of this article has elsewhere had occasion to state it: "The right to be of the political authority itself is not in issue, for, abstractly considered, that is, as apart from any particular form of organization, or manner of operation, there is no basis upon which a judgment may be founded. It is not until the state manifests its power and authority that material is afforded to which moral estimates may be applied."

The Doctrine of the "Consent of the Governed." — We are now prepared to examine the meaning and validity of that doctrine, promulgated in the Declaration of Independence, and accepted as fundamental in American political philosophy, according to which all governments "derive their just powers from the consent of the governed."

Without stopping to consider what the founders of the American Union probably meant by this phrase, it may be here said that the principle stated by it has a validity only in so far as it is held to state or imply that all governments should be so administered as to promote to as high a degree as is possible the good of all the governed; and that, therefore, the governed have at all times the moral right — though not necessarily the legal right — to see to it that this is done, and consequently the right, if there be no better way, of overturning an existing government and establishing in its place one more likely to subserve their own general good. Impliedly, then, the doctrine properly means that every state should be so organized as to render possible and easy the discovery of the best interests of the governed. As, however, generally speaking, these best interests are most certainly to be determined by the intelligent wishes of those concerned, this means, in the first place, that, so far as the state itself is able to provide them, agencies should exist for developing the intelligences of its citizens and thus qualifying them to know their own best interests; in the second place that adequate provision should be made for the free expression by the people of their wishes; and, finally, in the third place, that sufficient guarantees should exist that these wishes when made known will be heeded by those in power.

That the foregoing requirements of an ethically defensible government may be satisfied, it is necessary that all public officials shall be held strictly responsible, politically and civilly, for the manner in which they exercise the powers entrusted to them; that freedom of speech and press shall prevail; that the rights to petition, to assemble peaceably, and to bear arms shall exist; and that political privileges — the suffrage and the right to be elected or appointed to public office — shall be as widely extended as the intelligence and morality of the citizens will permit. Speaking negatively the doctrine of the "consent of the governed" does not support the legal right, nor, except in extreme cases, the moral right, of each individual citizen to refuse obedience to particular laws which he may consider unjust, nor at will to cast off his allegiance to his state, nor to claim the suffrage or public office as an abstract right.

The ethical right of one people forcibly to subject another people to its political authority, that is, to destroy the sovereignty of its state and annex its territory, as, for example, the right of the United States to control the political destinies of the Filipinos, or of England to extend her authority over the peoples of the South African Republic (Transvaal), and the Orange Free State, is a somewhat different question from that of the right of a particular government to exercise a control over its own citizens. There is an exceedingly strong presumption not only that a given people best knows its own interests and the means of advancing them, but that, stimulated by the consciousness of national independence, it will develop its latent potentialities in a manner that it will not, or cannot, do when subjected to an alien authority. But this presumption, however strong, is one that may be rebutted. It may be made sufficiently plain that a people, because of a lack of intellectual and moral development or a deficiency in natural ability and temperament, is not able either to perceive its own best interests or so to govern its conduct as to realize them when perceived, or, in determining upon its domestic or foreign policies, to give sufficient weight to the moral and legal rights of other states and their citizens. The interests of civilization are superior to those of any particular people. Judged from this general standpoint, it may, therefore, often happen that the forcible subjection of one people to the political rule of another is justified. This right of course appears most plainly in the case of the subjection of an uncivilized people to a civilized nation, but is not necessarily limited to such a case. The continued unsatisfactory political conditions existing among many of the peoples of South and Central America, of the races inhabiting the Balkan Peninsula and of the whole of the Turkish dominions certainly furnishes to the other states of Europe and America a very strong basis of right to intervention. The language of Prof. J. W. Burgess is hardly too strong when, after adverting to the fact that it is in the interest of the world's best civilization that law and order and the true liberty consistent therewith shall reign everywhere upon the globe, he declares that "a state or states, endowed with a capacity for political

organization, may righteously assume sovereignty over, and undertake to create order for, a politically incompetent population."

Classifications of Governments.— As many different classifications of governments may be made as there are characteristics of governments suitable for selection as differentiating elements or factors. The best known of these possible classifications is the one that has come down to us from ancient times, which divides the various kinds of political organization into three main classes, according as the supreme political control is in the hands of a single individual, in which case the government is known as a monarchy; in the hands of a few persons, when it is described as an aristocracy; or in the hands of the general citizen populace, when it is termed a democracy. A further, or sub-classification divides each of these three types into normal and corrupt forms, the corrupt monarchy being termed a tyranny, the corrupt aristocracy an oligarchy, and the corrupt democracy an ochlocracy or mobocracy. A still further subdivision divides monarchies into elective and hereditary according to the source whence the monarch derives his right to office; and into absolute or limited (or constitutional) according as the monarch in the exercise of his authority, is, or is not, controlled by definite constitutional principles and by the action of other governmental officials selected by the people; aristocracies into particular types according to the principle, wealth, or birth, upon which membership in the ruling class is determined; and democracies into direct and indirect according to whether their people directly participate in the control of the state or delegate the exercise of their sovereign powers to officials selected by and responsible to themselves. In the latter case the government is known as a representative democracy or republic. The Constitution of the United States, without defining the term, provides that: "The United States shall guarantee to every State in this Union a republican form of government." The Federal courts, though they have several times been called upon to construe and apply this clause, have never attempted directly to determine the meaning of the term "republican form of government." The eminent constitutional jurist, Judge Cooley, gives, however, the following definition which has been generally accepted as correctly expressing the meaning of the phrase as employed in American law and American political thought:

By republican government, he says, is understood a government by representatives chosen by the people, and it contrasts on one side with a democracy, in which the people or community as an organized whole wield sovereign powers of government, and on the other with the rule of one man, as king, emperor, czar, or sultan, or with that of one class of men, as an aristocracy. In strictness, a republican government is by no means inconsistent with monarchical forms, for a king may be merely an hereditary or elective executive, while the powers of legislation are left exclusively to a representative body freely chosen by the people. It is to be observed, however, that it is a republican form of government that is to be guaranteed; and in the light of the undoubted fact that by the Revolution it was expected and intended to throw off monarchical and aristocratic forms, there can be no question but that by a republican form of government was intended a government in which not only would the people's representatives make the laws, and their agents administer them, but the people would also, directly or indirectly, choose the executive. But it would by no means follow that the whole body of the people, or even the whole body of adult or competent persons, would be admitted to political privileges; and in any republican state, the law must determine the qualifications for admission to the elective franchise.

Another term, often used as synonymous with democracy, is popular government. Strictly speaking, however, this latter term should be employed not to designate any distinct form of political organization, but to describe any government the actual administration of which is to a considerable degree subject to the control of the people. A popular government is thus, in effect, a free government and as such is properly to be contrasted with a despotic government in which the will of the ruler or rulers and not that of the ruled controls. It is in this sense that we speak of the movement toward popular government as having made great strides in England and elsewhere during the last 75 years, though monarchical forms have still been retained.

So closely connected with the advance of popular government, as to be almost identified with it, has been the development during the last century of constitutional government. Those general principles, written or unwritten, that determined the governmental organization of a state and fix the legal competences of its several organs and officials, taken collectively, are termed its constitution. In this sense every state has a constitution, and its government may be spoken of as constitutional. But in its stricter and more usual sense, a constitutional government is one in which the principles determining its specific character, and the extent and mode of exercise of its powers, are definitely determined, and, in general, reduced to precise written statement, and embodied in an instrument or instruments which are not subject to abrogation or amendment except according to certain specified formalities. By this means not only are definiteness of authority, and responsibility of those in power secured, but guaranties provided that existing political liberties shall not be changed except under conditions which usually include a popular assent directly or indirectly given. The value of constitutional government is thus usually but not necessarily that in it the exercise or the direct control of sovereignty is placed in the hands of the people. Its essential feature is that the manner in which the sovereign power is to be exercised by the state is definitely determined. A constitutional government, may therefore, both in form and effect, be but slightly popular in character. In fine, then, the difference between a constitutional and a popular government is that in the former the attempt is made to render the citizens secure against arbitrary action on the part of their rulers; in the latter, means exist for discovering and enforcing the wishes of the governed. The progress of popular government and of constitutional government, has almost always gone hand in hand, for the reason that it is but natural that, once established in the effective control of their states, the citizen bodies should have sought to render their power secure by the adoption of instruments of government that might not be altered except under certain prescribed conditions.

The truest tests of the excellence of all governments are the facilities they afford for the formation of an enlightened opinion of the people upon matters of political importance and the precise ascertainment of that "general will"

when formed, and the exactness with which the policies it dictates are carried out in practice. The development of popular constitutional governments means that these results are being achieved to an increasing extent. As Prof. Lester F. Ward has said: "Government is becoming more and more the organ of social consciousness, and more and more the servant of the social will. Our Declaration of Independence, which recites that government derives its just powers from the consent of the governed, has already been outgrown. It is no longer the consent, but the positively known will of the governed, from which government now derives its powers."

A characteristic feature of almost all constitutional governments is the existence of a system of what have been called "checks and balances." According to this system the several functions of political rule are so distributed among different organs of government that no one of them is given sufficient power to assume an autocratic, despotic control of the state. Thus, in general, the making, the interpreting, and the enforcing of laws are placed in different hands. The executive is thus unable to take legal action without the authorization of the legislature, and the acts of both the legislature and executive are subject to review in the courts. Furthermore, the legislative body is usually divided into two chambers, the approval of both, together with that of the chief executive, being required for a valid act of legislation; executive officials are often elected for but short terms of office, and in case of nonfeasance or malfeasance of office are subject to impeachment and summary removal from office, and subject to civil and criminal suit for any illegal conduct while in office. In the United States of America the most powerful check of all consists in the fact that the courts have the power of declaring void all legislative acts inconsistent with the provisions of the written constitutions of the United States and of its constituent commonwealths. In those European states which possess written constitutions the courts have not this power, the legislatures being construed to be the judges as to the constitutionality of their own acts.

Presidential and Parliamentary Governments.— A very important classification of constitutional governments is that which divides them into Presidential and Parliamentary.

Presidential government, to accept the excellent definition of Burgess, "is that form in which the state, the sovereign, makes the executive independent of the legislature, both in tenure and prerogative, and furnishes him with sufficient power to prevent the legislature from trenching upon the sphere marked out by the state as executive independence and prerogative." Thus the governments of the United States and of Germany are of this type. Upon the other hand, "Parliamentary government is that form in which the state confers upon the legislature the complete control of the administration of law. Under this form the legislature originates the tenure of the real (though perhaps not the nominal) executive, and terminates it at pleasure; and under this form the exercise of no executive prerogative, in any sense and manner unapproved by the legislature, can be successfully undertaken." As further descriptive of this parliamentary type it should be said that this controlling power thus vested in the legislature, almost inevitably tends to become concentrated in its more popular chamber. The government of England best illustrates this form of government. That of France may also be placed in this category. Because the real executive power in a parliamentary government is almost always in the hands of a cabinet of officials holding office only so long as they are able to retain the support of the legislature, this form of political rule is often spoken of as Cabinet government.

The Sphere of Government.— The legal power of a constitutional government at any given time is determined by law. The sphere of political control thus marked out includes all those interests which the state has determined require public control. As we have already learned, legally the state is omnipotent, and therefore may subject to its regulation any matter that it sees fit. Actually, however, considerations of utility and expediency of course control. Regarding the exercise of certain powers, no opportunity for the employment of discretion exists. In order to maintain itself as a sovereign, independent body-politic, it is absolutely necessary that the state should obtain sufficient means, and exercise sufficient authority, to protect itself against attacks from foreign sources, and to maintain law and order, that is, to protect persons and their property throughout its own dominions. The powers, the exercise of which is thus called for, may, therefore, be termed "essential powers," and in the aggregate they constitute the essential sphere of the state. By some writers they are spoken of as "police powers." German writers, however, it should be said, use this term somewhat differently, designating as a "Police State" (*Polizeistaat*) one that English and American writers denominate a "Paternal State." The propriety of the exercise by the political power of these essential duties is not denied by any one except the anarchist. Contrasted to these essential, or, to use the adjective employed by President Wilson, the "constituent" functions of government, which must be exercised by a state in one way or another, are what may be called the non-essential or ministrant functions which all civilized states to a greater or less extent exercise. The activities included in this class are those performed by the state for the promotion of the economic, physical, and moral welfare of its people.

As not being absolutely essential to the very existence of the state, there are many who while admitting the necessity for, and the rightfulness of, political control in matters of police protection and national self-defense, assert that the assumption by the state of a right thus further to control the conduct of its citizens, is an ethically unjustifiable interference with their freedom, even though the aim of such interference is to advance their own good. In order to maintain this position, however, they are obliged to fall back upon a doctrine of "natural rights," the invalidity of which is now all but universally recognized. Starting, as from a premise, with the right of a particular state or government to be, as determined by the principles already laid down in this article, the conclusion necessarily follows that, in each

individual case, the question whether or not a given matter, whatever its character, shall be subjected to public control, is one the answer to which should be determined wholly by expediency — construing of course expediency so as to include moral as well as material considerations. The arguments of those who urge the establishment of a socialistic or communistic régime are, therefore, not to be met by the simple predication of an abstract individualistic, *laissez-faire* doctrine, according to which an extension of state activities beyond the mere maintenance of order and national independence, is ethically unjustified whatever the results to which it may lead. The claims of socialists and communists, in other words, may properly be rejected only by showing that the actual results to which their proposed politics, if adopted, would in all probability lead, would be ethically unjust, or economically disastrous, or both.

This is not the proper place to discuss either socialism or communism. This one observation may be made, however, that the performance by the state of non-essential duties is not, in very many cases, a step toward socialism. The essential aim of socialism is to suppress competition. When there is assumed by the state a function which otherwise would certainly, or in all probability, not be performed at all, it can hardly be said that the field of private initiative is thereby lessened. Under the head of these non-essential, non-socialistic duties, may be grouped all those state activities that are educative rather than coercive, informative rather than controlling. Of this character, for instance, is almost all of the work done in the Departments of Labor and Commerce, and of Agriculture, the Bureau of Education, the Fish Commission, and other scientific bureaus of the United States government.

As to what the actual sphere of government in America and Europe is destined to become within the next few years we, of course, can only speculate. The probabilities, however, would seem to be that we are to see a considerable extension of state activities in the sphere of these non-essential, non-socialistic functions. The movement in this direction has for some time been very pronounced and is certainly one not to be deprecated. In the field of socialistic activities, namely, those the exercise of which by the state almost necessarily involves a corresponding diminution of the field of possible private enterprise, the greatest extension of public control within the immediate future will in all probability be seen in the assumption of the ownership and control by central and local governments of the so-called natural monopolies, and in the regulation by law of privately owned and managed industries in which the interests of the general public have become pronounced. Whether the movement toward increased governmental control in this last respect will proceed as rapidly as it has done during recent years one cannot say. The observation may be made, however, that, together with those forces, which, born of the increasing complexity of our social and economic life, tend to make necessary an extension of the activities of the state, there are other agencies the influence of which may be in the opposite direction. Out of an increased intellectual enlightenment and a more widely diffused spirit of altruism may easily arise both an increased ability and a stronger disposition to solve social and economic problems without a resort to the coercion of law. See STATE.

W. W. WILLOUGHBY,
Johns Hopkins University.

Government by Injunction, a term used to characterize the putting down of strikes by judicial power of laying injunctions. The first direct interference of the national government in labor troubles was the dissolution of the great Pullman strike at Chicago in 1894, on the ground that it interfered with the carrying of United States mails. This was an executive act; but the courts have since interfered in cases where violence was making the transaction of government business impossible, and brought irresistible government power to bear.

Government Printing House, a large printing establishment at Washington, D. C., controlled and operated by the government for the publication of congressional proceedings, department reports, scientific bulletins, etc. It is considered the largest printing-office, public or private, in the world. A new building was erected in 1902 for its accommodation at a cost of about $2,500,000. Its floor space represents a total area of 14 acres. More than 4,000 persons are employed in this establishment. The cost of maintaining the establishment approximates $6,000,000 per year.

Government of the United States. See UNITED STATES.

Governor, in the United States. The head of an English trading corporation, as the East India Company or the Bank of England, was called the governor; hence it was natural to give that title to the heads of the colonies which grew out of them. These governors were elected by the people in Connecticut and Rhode Island, and down to 1686 in Massachusetts; in the crown colonies they were appointed by the sovereign, and in the proprietary colonies by the proprietor. The name, from the long struggles with the royal governors, had a disagreeable sound in the public ear in many colonies; and when the Revolution swept these away, in several cases they were replaced by councils, of whom the president or chairman was really the governor. Hence, in those times "President" of a State was often used as a current though not official title. Where and when a single executive was adopted, south of New York he was at first usually chosen by the legislature. At present, in most States the governor has a veto, which may be overridden in all cases by a two thirds vote of both Houses, and in some by a bare majority. Sometimes he has the power of granting pardons; in other cases he is one member of a board of pardons. He sometimes appoints commissions and executive boards. He is always commander-in-chief of the State militia, and is obligated to assist local officers in suppressing insurrections, and is empowered to call on the President for help if necessary; in turn, he is the President's chief agent in furnishing men and supplies in case of national war. And like the President, he sends a message to the legislature at the beginning of each session, recommending such legislation as he wishes.

Governor, a device which regulates the admission of steam to a steam-engine, according to the rate of motion. The intention is to maintain uniform velocity, and any acceleration of speed above a given rate causes a valve to be partially closed, diminishing the area of steam passage. The favorite form of governor has a pair of balls suspended from a vertical shaft, so as to swing outward when the shaft is rotated. The greater the speed the greater the centrifugal force, and consequently the farther the balls depart from the axis of rotation: the inclination of the ball arms is made effective in working the valve. See STEAM-ENGINE.

Governor's Island, a small fortified island in New York Bay, south of the Battery, and at the entrance to East River. It is separated from Brooklyn by Buttermilk Channel. In 1621, under the name of Nutten Island, it was a station of the West India Company. Later it was used as a residence by the colonial governors of New York, hence its present name. Wouter Van Twiller was the first governor (1637) to use the island for a country residence. In 1708 it was in use as a quarantine station, and in 1784 Gov. George Clinton leased the island to a company who used it for a summer resort and a race-course. Lord Cornbury in 1702 and Gov. Hardy in 1756 urged the erection of batteries on the island: but no definite action was taken until 1794, when there were rumors of a war with France, the State of New York appropriated $250,000 for the erection of a fort and earthworks. The general government appropriated $31,117, and the money was expended for the construction of Fort Jay in the centre of the island. Other sums were used later in improving the fort, but in 1801 the work ceased until 1806–7, when from "an enclosed work of earth and wood" the fort was improved and faced with permanent masonry at a cost of $30,000, and was named Fort Columbus, as at present. The designs for Fort Columbus, also Castle Williams, were made by Jonathan Williams, Lafayette's chief engineer of the army. The plans called for 104 guns for Fort Columbus and 100 guns for Castle Williams. The latter fort exists to this day (1903) practically as it was when completed in 1811. Its area is three fifths of a circle which is 200 feet in diameter, and the walls are 40 feet high. In 1861–5 Castle Williams was used as a prison for Confederates; at one time there were as many as 1,000 prisoners. After the War of 1812 a fortification called South Battery was built at a place to command Buttermilk Channel. Governor's Island is the army headquarters of the Department of the East, a most important military post, embracing the coast from Maine to Florida and including Porto Rico. It has less the look of war than many smaller forts, but it has a garrison usually of three companies, and it is used as a military prison, nearly all the prisoners being deserters. A little church, under the care of Trinity parish, Manhattan, residences for the officers and some storage places are the only buildings in addition to the forts. At the beginning of the 17th century the island was 1,500 feet long and 900 feet wide with an elevation above high-water of 20 feet. Its whole area then was 100 acres. The tide-waters have washed away a large portion of the island, and now (1903) the area is only 65 acres. The War Department has begun the work of reclaiming from the sea the land washed away. It is expected that in 1904 or 1905 the island will be restored to its former area. The need of modern forts and better defensive equipment on Governor's Island no longer exists since an excellent system of fortifications has been established at the entrance to The Narrows and along the shores of Long Island Sound.

Governor's Island, a fortified island belonging to Suffolk County, Mass., in Boston harbor. It is just north of the main ship-channel and of Castle Island. The fortifications form part of the system of defense of Boston harbor. Fort Winthrop, the keep or réduit, is an enclosed quadrangular fort with open barbette batteries.

Gow'er, John, English poet: b. probably about 1330; d. London October 1408. But little is known of his life save that he was rich and well educated, did not marry till late in life, and became blind about 1400. His tomb is still to be seen in St. Saviour's, Southwark. He was a personal friend of Chaucer, who, in dedicating to him his 'Troilus and Cressida,' addresses him as the "moral Gower" — an epithet that has indissolubly linked itself with his name. Gower wrote three large works in as many languages: the 'Speculum Meditantis,' in French verse, not now extant; the 'Vox Clamantis,' a tedious poem in Latin elegiac verse, written 1382–4, describing the rising of the mob under Wat Tyler; and the long poem entitled 'Confessio Amantis,' written "in our English . . . for England's sake," the date uncertain, but at least the poem was in existence in 1392–3. There are extant also 50 French ballads, written by Gower in his youth (Roxburghe Club, 1818).

'Confessio Amantis' consists of a prologue and eight books, written in verses of eight syllables, rhyming in pairs. The long prologue gives a sombre account of the state of the world at that time, and the poem opens by introducing the author himself in the character of an unhappy lover. It ends with the lover's petition in a strophic poem addressed to Venus, her judgment, and finally the lover's cure and absolution. Without originality, narrative power, pathos, or humor, Gower yet commands respect for the laborious equality of his verse, and his work remains a splendid monument of English. The best edition is that by Pauli (1857). There is a serviceable reprint by Henry Morley in his 'Carisbrooke Library' (1889).

Gower, LORD **Ronald Sutherland,** English author and sculptor: b. 1845. He was the second son of the 2d Duke and 20th Earl of Sutherland. Educated at Trinity College, Cambridge, he sat in Parliament for Sutherland, and also became known as the sculptor of such works as 'The Old Guard at Waterloo,' and the Shakespeare monument at Stratford-on-Avon. Among his writings are: 'My Reminiscences' (1883), a work of much interest; 'The Tower of London' (1901); and 'Old Diaries.'

Gowrie (gow'rĭ) **Conspiracy,** an unexplained episode in Scottish history. On 5 Aug. 1600, James VI., afterward James I. of England, came to Gowrie House, the residence of the Earl of Gowrie, in the suburbs of Perth, having been lured thither, according to one account, by the report of a suspicious person there held in

custody. After dining, the king was led aside by Alexander Ruthven, younger brother of the earl, and the king's attendants were told that his majesty had left the castle. An attempt was made by Ruthven, either to murder or to bind the king, who struggled desperately and shouted for help. His retinue coming to his rescue slew Ruthven and Gowrie. The motives of the two brothers have been variously explained. The current belief is that they intended to capture the king and either give him up to England or administer the government in his name in the interest of that country and in that of the Scotch Presbyterian leaders. Others supposed that their object was merely to avenge the death of their father, who had been executed a few years previously. The heavy indebtedness of the king to Gowrie was another cause of irritation. Gowrie House was destroyed and the estates confiscated.

Goyanna, gō-yän'nä, Brazil, city in the state of Pernambuco; on the Goyanna River, about 20 miles from the Atlantic. It is a shipping port for sugar, dyewoods, cabinet woods, and cotton. Pop. 5,000.

Goyaz, gō-yäz', Brazil, a state completely enclosed between the states of Maranhão, Piauhy, Bahia, Minas Geraes, São Paulo, Matto Grosso, and Pará. Its area is estimated at 747,311 square kilometres, or, say, 287,714 square miles; but, as a large part of the Araguaya-Tocatins basin is unexplored, a precise statement in regard to the extent of its territory cannot be justified. The Goyaz plateau with the Pyreneus Mountain range constitute the watershed which divides the basin of the Tocatins and Araguaya rivers from the São Francisco and Paraná basins; the headwaters of the Araguaya and the Paraguay are near one another; and thus the point of divergence of great river-systems is found within this state. The climate of the plateau is excellent; among the mountains extremes of heat and cold are felt; and large districts are well adapted to agriculture. Forests extend along the river-courses, while the elevated lands of the interior have only occasional clusters of trees. The chief products are tobacco, rubber, and cattle; the gold and diamond washings which at one time were supposed to be important now yield very little. The capital, Goyaz, formerly called Villa Boa, has about 8,000 inhabitants. The population of the state was given as 260,395 in 1901, but of that number nearly all were Indians or Mestizos, the civilized element being inconsiderable as yet. The special interest attached to this state is due to a circumstance which is mentioned in a geographical sketch of Brazil (Washington 1901; compiled by the Bureau of the American Republics), in the following terms: "This state enjoys a splendid climate, and has been selected for the site of the future capital of the republic, the constitution providing for its location on the plateau of Goyaz. A special commission, at the head of which is the director of the observatory of Rio de Janeiro, has already marked the site for the new capital, which is a space 14,400 kilometres square on the Upper Tocatins, in the Pyreneus range of mountains. It has an elevation of from 200 to 300 metres above the level of the plateau and is drained by numerous streams of pure water, being the centre of the three hydrographic systems of Brazil. . . . It is here, near the point of divergence of her three great rivers, that Brazil wishes to establish the national capital." But the site thus selected has no natural means of communication with the Brazilian coast. The Tocatins-Araguaya is navigable for only about one tenth of its entire length; its course is broken by falls and rapids, and as it approaches the Gulf of the Amazon it becomes very shallow. Canals and railways would be required in order to make the rivers commercial highways; moreover the state is without seaboard — is, indeed, far inland. The isolation of the proposed capital suggests that of Bogotá.

MARRION WILCOX,
Authority on Spanish America.

Gracchus, grăk'ŭs, **Tiberius Sempronius** and **Gaius Sempronius,** two Roman statesmen: b. about 163 B.C. and 159 B.C.; d. 133 B.C. and 121 B.C. In their attempt to obtain reforms favorable to the commons, they awakened popular commotions of which they themselves became the victims. Tiberius served under the command of his brother-in-law, the younger Scipio, at the siege of Carthage, and was the first man to mount the walls. He was subsequently quæstor to the consul Mancinus, who at that time waged war against the Numantines in Spain. After the defeat of Mancinus, he concluded a treaty with the Numantines, which, without being disgraceful to the Romans, secured to the Numantines their independence. This treaty, however, was opposed by the aristocratic party and repudiated by the senate. Tiberius, nevertheless, upheld by the populace, in 133 B.C. was elected tribune of the plebs, and sought to reform the condition of the poorer citizens who were without land, and, since the great estates of the wealthy were cultivated by slaves, also largely without employment. He endeavored to attain his object by the revival of the Licinian Rogations of 367. It had been decreed, on the proposition of the tribune, Licinius Stolo, "that no one should possess more than 500 acres (*jugera*, each 28,000 square feet) of the public domain (*ager publicus*), and that the overplus should be equally divided among the plebeians." This law, which was now called the Gracchan, the Sempronian, or by way of eminence the agrarian law, he revived, but with the introduction of several softening clauses. The proposition of Tiberius Gracchus was met with the most determined opposition by the ruling party. To counteract his plans the senate gained over one of the tribunes, Marcus Octavius; and when Tiberius, after having, according to custom, exposed his law 19 days to the public view, proceeded to take the votes of the assembled people upon it, Octavius interposed with his veto, and thus seemed at once to have defeated the whole undertaking. Tiberius now exerted all the prerogative of his office, sealed up the treasury, and forbade all the authorities the discharge of their several offices. He saw, however, that this was of no service to his plan. He therefore took a step till then unheard of in Roman history. At the next assembly of the people he obtained the expulsion of Octavius from office, as faithless to the cause of the people. The bill was thus passed, and a committee consisting of Tiberius himself, his brother Gaius, and his father-in-law Appius Claudius appointed to carry out its various provisions. All the difficulties which

stood in the way of the law now appeared in their full light. Even the preparatory business of ascertaining which was the public land, and which private property, was found to have its full share. Outcries and complaints were made from every part of Italy. When June of the following year came on, in which the tribunes for the next year were to be elected, Tiberius, who had endeavored to regain the favor of the people by some new propositions, offered himself again as a candidate for the office. The aristocrats used every effort to prevent his election, and the ferment in Rome was carried to the highest pitch. One election day went by without any election being made. On the next a vast multitude beset the forum, and the senate assembled in the neighboring Temple of Faith (Fides). Tiberius strove in vain to speak, and was killed in the tumult which followed. The place of the murdered Tiberius was filled by Licinius Crassus, father-in-law of Gaius Gracchus; and on his death Carbo, Fulvius Flaccus, and Gaius Gracchus constituted the committee appointed for the enforcement of the law.

In this way the parties had struggled with varying success, when, in 123 B.C., the younger Gracchus, who, as quæstor, had been with the army in Sardinia, obtained the tribuneship. With more various and shining talents than his brother, he united a stormy eloquence, which carried away his hearers. In the discharge of his office as tribune he first of all renewed his brother's law, which had meanwhile fallen into disuse, and revenged his memory by expelling many of his most violent enemies from the city. At the same time he carried through a law "that every month corn should be sold to the poor at a low fixed rate," and by another law effected some alleviations in the rigor of the military service, and ensured for the soldiers clothing, besides their pay. The people were animated with an unlimited enthusiasm for their favorite; his enemies were terrified and weakened; hence he obtained the renewal of his office for the following year with ease. His attempt to introduce 300 knights into the senate failed; but on the other hand, at his proposal the administration of justice was taken from the senate and transferred to the equestrian order. This gave rise to a new political power in the Roman commonwealth, which, holding a station intermediate between the senate and the people, had a most powerful influence in its subsequent history. The senate now resorted to a new but sure means of destroying Gaius. Livius Drusus, a tribune gained over to their interests, had the art to withdraw the affections of the populace from Gaius by making greater promises to them, and thus obtained a superior popularity for himself and the senate. Hence it resulted that Gaius did not obtain a third tribuneship, and Opimius, one of his bitterest enemies, was chosen to the consulate. In the ensuing civil disturbances Gaius was killed at his request by his slave.

Grace, William Russell, American merchant: b. Queenstown, Cork, Ireland, 10 May 1832; d. New York 21 March 1904. In 1846 he worked his way on a sailing vessel to New York; in 1850 went to Callao, Peru, where he became a clerk in the shipping office of Bryce & Company, and later partner in the firm, which eventually assumed the style of Grace Brothers & Company. He organized the firm of W. R. Grace & Company, now the leading American house in the South and Central American trade, with main offices at New York, and branches at London, San Francisco, Lima, Callao, Valparaiso, Santiago, and Concepcion. In 1891 he also established the New York and Pacific Steamship Company. He was Democratic mayor of New York in 1881–2 and 1885–6. His philanthropies were numerous, including the gift of one fourth the cargo of the U. S. S. Constellation, despatched to the aid of the Irish famine sufferers of 1880; and large sums for the building and maintenance of the Grace Institute, established by him in 1897 at New York for the instruction of women in domestic arts and sciences, trades, and occupations. He became a member of the American Museum of Natural History and the American Geographical Society, and organized and was elected president of the Nicaraguan canal syndicate, an organization of capital for securing to the United States control of the waterway.

Grace of God, an expression borrowed from St. Paul's writings. The Apostle frequently employs the term grace in the sense of a gift which enables those who have it to do what they could not do without it. In common parlance we use such expressions as the "gift of music," the "gift of poetry," as belonging to one who might acquire many accomplishments, but could never acquire what is meant by a gift for anything. St. Paul, speaking of his own conversion, his calling to the apostolate, and his many labors, says: "By the grace of God I am what I am." Again he addresses his followers in these words: "By grace are ye saved; not of yourselves, it is the gift of God."

The Church of England and the Protestant Episcopal Church in the United States teach that grace is the assistance given by God to those who believe in Him, so that they may please Him and keep His commandments. All the Reformed Churches agree on this point and they also agree that no man can do good works "as God hath willed and commanded them to be done" (39 Articles), that is, from a right motive and in a religious spirit of devotion, without the grace of God. They also teach that the principal means of grace is prayer, and study of the Scriptures, which latter make a man "thoroughly furnished unto all good works" (1 Tim. iii. 17). To these means of grace the Catechism in the Book of Common Prayer adds the two sacraments, of Baptism and of the Lord's Supper, which are not only means of grace, but also "outward and visible signs" and "pledges" of the grace received by those who participate in them. The following is the doctrine of the Roman Catholic Church regarding grace, which that Church has made plain by dogmatic definitions. As defined by the eminent Roman Catholic theologian, Perrone, grace is "that gratuitous inward aid (*auxilium*) which God affords to fallen man through Christ's merits, to enable him to perform supernatural acts, so that he may attain justification and persevere therein" (Prælect. Theol., c. de Gratia). The Roman Catholic Church's doctrine of grace is opposed on one side to the teachings of Pelagius, who denied the necessity of grace, and on the other to the teachings of those who held that without grace every act of man is a sin, and specifically

that "the constancy of Socrates, the continence of Xenocrates . . . must be regarded, not as virtues but as vices" (Melanc. Loci Theol.); and that "from man's corrupt nature proceeds naught that is not worthy of condemnation" (damnabile: Inst. i. 2). Roman Catholic doctrine holds the middle ground between these extremes. As against the Pelagians the Roman Catholic Church teaches that for all acts conducive to salvation (*salutares*) the inner grace of the Holy Spirit is necessary (Conc. Trid. Sess. VI., can. ii. 3). As against Melancthon, Baius, and the Jansenists, the same Church teaches that fallen man, before he receives the gift or grace of faith, can perform acts that are morally good. Further, the Roman Catholic Church, in opposition to the teaching of Calvin, teaches that a man once justified may fall from that state. Again, the Roman Catholic Church teaches that in all his acts conducive to salvation (*salutaribus*) man is free; in other words, grace imposes on man no necessity.

The Council of Trent in Can. iv. of Sess. VI., thus defines the Roman Catholic doctrine of the freedom of man's will while co-operating with grace: "If one shall say that man's free will, moved and stirred by God, co-operates not, by giving assent to God so inciting and calling, toward disposing and fitting himself for grace of justification; or that he cannot, if he wishes, dissent; but that like some lifeless thing he cannot do anything at all and is wholly passive: be he anathema." The Roman Catholic Church further teaches that the state of grace and holiness in which man was constituted in Paradise was supernatural, something added to the perfection of his human nature; in contradiction to those who teach that this state was in the same sense natural to him as any of his mental or bodily faculties. In consistency with this view such teachers hold that in his fall Adam lost all power and faculty for doing any good act, and that whatever he did was sin.

Graces (Greek, *Charites,* translated by the Romans *Gratiæ*), the goddesses of grace, from whom, according to Pindar, comes everything beautiful and agreeable, through whom alone man becomes wise and glorious. According to Hesiod, and most poets and mythologists, Zeus was their father, and Eurynome their mother. Hesiod gives them the names of *Aglaia* (brilliancy), *Thalia* (the blooming), and *Euphrosyne* (mirth). Homer mentions them in the 'Iliad' as handmaids of Hera (Juno), but in the 'Odyssey' as those of Aphrodite. He conceived them as forming a numerous troop of attendant goddesses, whose office it was to render happy the days of the immortals. Later poets considered them as allegorical images. They not only improve corporeal charms, they have an influence also upon music, eloquence, poetry, and other arts; and the execution of acts of benevolence and gratitude is likewise superintended by them. In the earliest times the statues of the Graces represented clothed forms; at a later period they were represented as nude. They had many temples in Greece, partly dedicated to them alone, partly in common with other deities, particularly Aphrodite, the Muses, Eros, Hermes, and Apollo. Their festivals were called in Greece Charisia. It was customary to swear by the Graces, and libations of wine were offered them at meals. The most celebrated Graces of modern sculpture are those of Canova and Thorwaldsen.

Gradientia, grā-dĭ-ĕn'shĭ-a. See Urodela.

Gradual (Lat. *Graduale*), in the liturgy of the Roman Catholic Church, an antiphon which is sung by the choir or recited by the celebrant of the Mass, immediately after the intoning or the reading of the Epistle (first lesson). The gradual nearly always consists of two or three verses from the Psalms, suggestive of thoughts pertinent to the office of the day. Thus the gradual for the festival of Holy Innocents (28 December) is from the 123d Psalm (in the English Bible 124th): "Our soul is escaped even as a bird out of the snare of the fowler: the snare is broken and we are delivered; our help standeth in the name of the Lord who made heaven and earth." *Graduale* or *Liber Gradualis* is also the name of a service-book of the Latin Church's liturgy: it takes its name from the gradual as just explained, and contains all the graduals for the Sundays and festivals of the entire year, for the use of the choir.

Graduation Act, of 4 Aug. 1854, "An Act to Gradually Reduce the Price of the Public Lands to Actual Settlers." All public lands which had been in the market for 10 years and upward prior to the passage of the act were to be sold for $1 per acre; all 15 years, 75 cents; all 20 years, 50 cents; all 25 years, 25 cents; all 30 years, 12½ cents — except United States reservations, grants to States for railroad purposes, or mineral lands held at over $1.25 per acre. No one was to have over 320 acres including lands previously taken up.

Gra'dy, Henry Woodfin, American journalist and orator: b. Athens, Ga., 24 May 1850; d. Atlanta, Ga., 23 Dec. 1889. He was graduated from the University of Georgia in 1868, studied at the University of Virginia in 1868–70, began his journalistic career with contributions to the Atlanta *Constitution,* and for that journal in 1870 described a press tour of Georgia and the resources and possibilities of the State. At Rome, Ga., he edited the *Courier,* and later established and edited the unsuccessful *Daily Commercial.* In 1871 he became Georgia correspondent of the New York *Herald,* and in the same year purchased an interest in the *Herald* of Atlanta, publication of which was suspended in 1876. He then established the *Courier,* which did not long continue, and in 1880 bought a quarter interest in the *Constitution,* of which paper he remained until his death editor and part owner. He was an able journalist, writing for the New York *Herald* some noteworthy letters, including an account of the Hamburg riots in South Carolina; and while editor of the *Constitution,* publishing in its columns vivid descriptions of the Charleston earthquake, and in various magazines articles on the condition and promise of the South. He also became locally known for his oratory, largely through his lecture, 'Just Human,' given at Atlanta. In 1886, at the annual banquet of the New England Society in New York, he made a distinguished address on 'The New South,' which was widely printed and at once gave him a national prominence. Other well-known speeches by him were one on prohibition at Atlanta in 1887, one at the Texas State Fair in Dallas in 1888, and his final and greatest effort, 'The Future of the

HENRY WOODFIN GRADY.

Negro' (December 1889), before the Merchants' Association of Boston. Grady was the first to present to the North the views of the more enlightened portion of the reconstructed South,— its belief that the "struggle between the States was war and not rebellion," but at the same time its readiness to identify itself with the united progress of the nation. His eloquent services in this behalf were of much importance. He aided in the establishment of the Confederate Veterans' Home, the election of Gen. J. B. Gordon as governor of the State, and the organization of the Atlanta expositions of 1887 and 1889. He declined public office, but was frequently mentioned for nomination to the United States Senate. Consult the 'Life,' by Lee (1896).

Graebner, grĕb'nėr, **August L.,** American Lutheran theologian: b. Frankentrost, Mich., 10 July 1849. He studied at Concordia College (Ft. Wayne, Ind.) and the Concordia Theological Seminary (St. Louis, Mo.), was ordained to the Lutheran ministry in 1878, and was professor of theology in the Lutheran Theological Seminary from 1878–87. In 1887 he became professor of theology in Concordia College (St. Louis). His writings include theological works in German; and in English: 'Life of Luther' (1883); 'Life of John Sebastian Bach' (1885); 'Outlines of Doctrinal Theology' (1898); and other volumes.

Graffiti, grăf-fē'tē, the name given by archæologists to the rude designs and inscriptions of popular origin drawn or engraved with the style upon the walls of ancient towns and buildings, particularly of Rome and Pompeii. Many of these are valuable for the light they throw on popular habits and modes of thought, and the illustrations they often in consequence afford of ancient authors. Graffiti have been found in Greece and Egypt. Some are traced with chalk or plaster, but the majority are scratched on stone or plaster with the stilus, which helps to account for their preservation. Those in Pompeii are found in the Latin, Greek, and Oscan languages, showing that the ancient language of Campania was still extant among a portion of the populace. The inscriptions are most frequently amatory or humorous, sometimes malicious or obscene. In Rome they occur frequently in the catacombs, particularly of Sta. Agnese and San Calisto. Many of these are by Christians, some by Pagans, in ridicule of Christianity. See GRAPHITOLOGY.

Graft'age, the process and practice (origin unknown) of propagating plants by the insertion in one of a bud (stock) or twig (scion) of another. It also includes the discussion of all questions relating thereto. The stock may be a complete plant, as in peach budding, or only a part, in which case it may be either a root or a stem part. In some instances (inarching, see below) both plants may have roots. Since the process is dependent upon the coalescence of the cambium (q.v.) of stock and scion the first essential is to make these two surfaces abut; the second is to check evaporation from the cut surfaces.

The many scores of styles of graftage fall naturally into three main groups:

1. *Inarching,* or *grafting* by *approach,* the uniting of two plants before the severance of the scion from the plant upon which it grows. After union the scion is severed below the point of contact and the parts of the stock above this point are removed. The method is rarely practised except with subjects hard to graft by more popular methods and for correcting defects of form, such as Y-crotches in fruit trees, a living brace being formed between the two arms. Since it is the only graftage found in nature, it is supposed to be the progenitor of modern methods.

2. *Budding* or *bud-grafting,* the inserting of a single bud beneath the bark of the stock or in some cases (for example, annular or ring budding) in the place of a piece of bark removed. It is always practised upon small stocks preferably under two years old and always when the bark readily separates from the wood as in spring or late summer. Since spring is a very busy season in nurseries, budding is practically all done during summer. The universally popular method is the shield, so-called from the shape of the scion. It is practically the only method employed in propagating the stone fruits — peaches, plums, etc. The seedling stocks, which are usually not less than one fourth inch in diameter, are stripped of their leaves close to the ground, are cut through the bark twice on the shady side, the cuts forming a T, the bark lifted gently with the specially formed ivory knife-handle, and the bud inserted and tied with raffia, bast, or cotton. A small portion of the bark and a little of the leaf stalk accompany the bud, the latter to act as a handle. In about two weeks, if the bud has taken, the binding is cut on the side opposite the bud to prevent "strangulation." In case of a failure other attempts are made. No visible growth occurs during that season, but in the spring the bud should become a shoot and the original top of the seedling stock should then be cut a few inches above the union, and later, when the union is firm this stub is cut off short. At the close of that season the tree is ready for sale.

3. *Grafting proper,* the inserting of a twig into a stock. The methods under this heading may be divided according to the maturity of the scion whether dormant or growing, and also as to the position the graft occupies, whether upon the root, the crown, the stem or the branches. By far the largest amount of grafting is done with dormant wood, and probably upon roots, though grafting upon the branches is widely popular. In *whip-grafting,* which is the one most practised with roots, especially in the nursery propagation of apples and pears and performed in early winter, the seedling roots are specially grown and are as nearly the size of the scions as possible. Both stock and scion are formed alike, two cuts being made, one rather long, diagonally across, and the other parallel with the direction of growth, thus forming a sort of tongue. The tongue of each is then fitted into the slot of the other, the pieces wrapped with waxed string, and stored in a moist, cool place until spring, when they are planted in the nursery. Usually they are sold after two seasons' growth.

Cleft-grafting is most frequently used upon parts of trees above ground or with grapes just below the surface. The stock is sawed across at right angles to the direction of growth, split

with a knife and held open with a wedge until the twigs (scions) bearing two or three buds and whittled to a wedge form below are inserted, one at each end of the slit. The wedge is then removed and the wounded surfaces waxed. This method is practised most upon stocks too large for whip-grafting, limbs even as large as three inches in diameter being sometimes used. As a rule small stocks give more satisfactory results. The method is universally employed to change long-established trees to other varieties.

Some other frequently employed methods are: (1) *Bridge-grafting*, which is used for saving young trees that have been girdled by mice or rabbits or otherwise deprived of their bark. The edges of the injured surface are trimmed above and below, and scions, with wedge-shaped ends, are fitted beneath the bark at each of these points. The whole is then covered with wax. Any sprouts that appear are rubbed off so as to force all growth into the stem. The scions soon unite upon their sides as well as to the original trunk. (2) *Veneer-grafting*, which is widely used in greenhouses, consists in inserting a scion upon the side of the stock, binding and protecting it from the air. The method is practised with both ripened and immature wood.

Protection from the air is gained in budding by bringing the bark of the stock in close contact with the scion and by bandages; in grafting, by applying a bunch of damp moss (a greenhouse practice) or covering of grafting wax, grafting clay, etc. (outdoor practice). One of the most popular waxes is made as follows: Melt and thoroughly mix together 3 pounds of mutton tallow, 5 of beeswax, and 10 of resin; pour into cold water and work with the hands until the color of pulled molasses taffy. Apply closely while warm enough to spread readily by pressure of the hand. For use in *whip-grafting* balls of woolen yarn are soaked in melted wax and wound around the grafts. Soft waxes are less useful, since they are likely to melt on warm days and in warm climates. No horticultural practice except that of cuttage can compare with graftage in extent of usage and apparent necessity. Like cuttage, its strong points are ease and certainty of operation, maintenance of a variety "true to type" with the comparatively rare exceptions of bud variation, and the modifications which it permits in the habits of plants. Some of the more important of these last are dwarfing, produced by grafting a strong growing scion upon a small growing stock, as pear upon quince; hastening or increasing fruitfulness, as when scions from bearing wood are top-grafted or budded upon young established trees already in the orchard; to counteract injuries (see *bridge-grafting* above); to change poor or unproductive trees into useful ones (see *cleft-grafting* above); to make possible the growing of certain trees upon uncongenial soils, as peaches budded upon plum stocks for heavy soils and plums upon peach stocks for light soils, etc.

Much popular misconception exists as to the limits of grafting. In many instances the possibilities have been found wholly within the individual species; that is, various different but related species fail to unite and grow. Generally, however, the limits are within the genus; for example, plums, peaches, cherries, apricots, etc., readily thrive upon one another. Again there are a few instances of different genera which unite, as among cacti. Genera are, however, arbitrary, man-made groups. Permanent unions between oaks and roses, grapes, and pears, and similar widely separated plants have not been reported by reputable horticulturists. Consult: Bailey, 'Cyclopedia of American Horticulture' (New York 1900–2); id., 'Nursery Book' (id. 1896); Fuller, 'Propagation of Plants' (id. 1887); Baltet, 'L'Art de Greffer,' and its English translation, 'Budding and Grafting.'

Grafton, Charles Chapman, American Protestant Episcopal bishop: b. Boston 12 April 1830. After a course in law at Harvard, he studied divinity and was ordained priest in 1858. He was rector of the Church of the Advent, Boston, 1872–88, and in 1889 was consecrated bishop of Fond du Lac. His writings include 'Plain Suggestions for a Reverent Celebration of the Holy Communion.'

Grafton, Mass., town in Worcester County; on the New York, N. H. & H., and the Boston & A. R.R.'s; about 6 miles southeast of Worcester and 9 miles northwest of Milford. In 1728 the first permanent white settlement was made, and the town was incorporated in 1735. As early as 1660 John Eliot (q.v.) established here a settlement of Indians whom he had converted. The manufactures are cotton goods, threads, boxes, boots and shoes, emery, and underclothing. Pop. (1900) 4,869.

Grafton, N. Dak., city, county-seat of Walsh County; on the Park River, the Great N., and the Northern P. R.R.'s; 15 miles west of the Red River of the North. It is in the great wheat region, and is the trade centre of Walsh County. It has grain elevators, flour-mills, and cattle-yards, and manufactures farming implements. It is the seat of the State Institute for the Feebleminded. Pop. (1900) 2,378.

Grafton, W. Va., city and county-seat of Taylor County, located in the northern part of the State, 100 miles southeast of Wheeling, and on the Tygart Valley River, and the Baltimore & O. R.R. The city is the terminus of four branches of the Baltimore and O. R.R., and owes its importance to the establishment of the Baltimore & O. R.R. machine shops. It also has flour and planing mills, a wooden pump factory, foundries, cigar and glass factories, and is also engaged in mining and agriculture. There are eight churches, public and parochial schools, and five banks, with a combined capital of $310,000, and there are two weekly papers published. A national cemetery is within the city limits containing 1,261 graves, 600 of which are nameless. Municipal affairs are administered by a mayor and council of eight members, elected for two years. The city owns its waterworks and electric lighting plant. It was founded in 1854, incorporated in 1856, and received its charter as a city in 1899. The population are mainly English and German. Pop. (1900) 5,650.

A. J. Wilkinson.

Graham, grā'am, **Charles Kinnaird,** American civil engineer: b. New York 3 June 1824; d. Lakewood, N. J., 15 April 1889. He entered the navy in 1841, during the Mexican war served with the Gulf squadron, after study of engineering was appointed constructing engineer of the Brooklyn navy-yard, whose great dry-dock and

landing-ways were built by him. At the outbreak of the Civil War he volunteered in the Federal army, and during the War he was twice wounded at Gettysburg and there taken prisoner; commanded the gunboat flotilla in Gen. Butler's expedition up the James River, and was brevetted major-general of volunteers (1865). He was successively chief-engineer of the New York dock department in 1873-5, surveyor of the port in 1878-83, and naval officer in 1883-5.

Graham, Isabella (Marshall), American educator and philanthropist: b. Lanarkshire, Scotland, 29 July 1742; d. New York 27 July 1814. From 1774 she was a teacher in Scotland, where, in Edinburgh, she inaugurated the work which led to the organization of the Society for the Relief of the Destitute Sick. In 1789 she removed to New York, and there for several years conducted a successful school. Her philanthropies were many, and were particularly in the interests of education, religious and secular. She founded in 1814 the Society for the Promotion of Industry Among the Poor.

Graham, James Duncan, American topographical engineer: b. Prince William County, Va., 4 April 1799; d. Boston 28 Dec. 1865. Graduated from the United States Military Academy in 1817, he entered the corps of topographical engineers, in which he attained major's rank in 1838, was astronomer to the survey which determined the boundary line between the United States and the republic of Texas (1839-40), and later United States astronomer in the joint survey of the boundary between the United States and the British provinces. In the determination also of the boundary between the United States and Mexico he held a similar post. Subsequently he directed harbor improvements in the lakes of the North and Northwest, in which he was the first to detect the presence of a lunar tide, and was superintending engineer of the Boston harbor sea-walls and of repairs in various harbor-works along the Atlantic coast.

Graham, John, Viscount Dundee, commonly called Claverhouse, Scottish commander: b. near Dundee, Scotland; d. Killiecrankie 17 July 1689. He went abroad and entered the service, first of France and afterward of Holland, but returned to Scotland in 1677, where he was appointed captain of a troop of horse raised to enforce compliance with the establishment of Episcopacy. He distinguished himself by an unscrupulous zeal in this service, and waged an exterminating war against conventicles. The Covenanters were driven to resistance, and a body of them defeated Claverhouse at Drumclog on 1 June 1679. The Duke of Monmouth, however, defeated the insurgents at Bothwell Brig on 22 June, and Claverhouse was then sent into the west of Scotland with absolute power, and exercised it in such a manner as to lead to the belief that in addition to the persecuting policy of his superiors he was actuated by personal revenge. The more terrible he made himself to the Covenanters the more acceptable his career was to the government. In November 1688, after William had landed, he received from James in London the titles of Lord Graham of Claverhouse and Viscount Dundee. When the king fled he retired to the north, followed, by order of the Convention, by Gen. Mackay. Claverhouse was joined by some of the Highland chiefs occupying Perth, and finally encountered Mackay in the pass of Killiecrankie, whom he defeated, but was killed in the battle. Attempts have been made by Sir Walter Scott and others to throw a halo of sentimentality and heroism around his character; but it is clear that he was the willing instrument of a cruel government, and had himself little sentiment or softness in his nature. See Napier, 'Memorials and Letters of John Graham of Claverhouse' (1859-62); Mowbray Morris, 'Claverhouse' (1887).

Graham, Sylvester, American reformer: b. Suffield, Conn., 1794; d. 1851. He studied at Amherst College, was ordained to the ministry of the Presbyterian Church about 1826, and became known as a lecturer on temperance and dietetics. His proposed cure for alcoholism was based upon a vegetarian diet. The article of food made of unsifted wheat flour and known as Graham bread was introduced by him into general use. His writings include: 'Bread and Bread-Making,' and the 'Graham Lectures on the Science of Human Life' (1839).

Graham, Thomas, D.C.L., Scottish chemist: b. Glasgow 21 Dec. 1805; d. London 16 Sept. 1869. He was educated at the University of Glasgow, and in 1828 communicated to the Royal Society of Edinburgh the results of experiments on the absorption of vapors by liquids. In 1831 he laid before the Royal Society of Edinburgh the result of a series of experiments on 10 different gases, from which he arrived at the conclusion that gases tend to diffuse inversely as the square root of their specific gravities, a conclusion which has been received as the law of the diffusion of gases. In 1837 he was elected professor of chemistry in the University of London, and soon afterward was appointed assayer to the mint. In 1840 he received the gold medal of the Royal Society, and the next year was chosen first president of the Chemical Society, which he had assisted in founding. He now began to be employed as consulting chemist in various mercantile and public undertakings, and it was by his recommendation that wood-spirit, or methylic alcohol, was used to render spirits sold free of duty for trade or scientific purposes unfit for consumption as a beverage. In 1846 he assisted in founding the Cavendish Society, of which he was elected president, an office he retained till the close of his life. At the same time he was engaged in investigations on the diffusion of liquids, and was the earliest to fully develop that theory. He made many other important discoveries, and was the author of 'Elements of Chemistry' (1837) and various professional papers.

Graham, William Alexander, American politician: b. Lincoln County, N. C., 5 Sept. 1804; d. Saratoga Springs, N. Y., 11 Aug. 1875. He was graduated from the University of North Carolina in 1824, was admitted to the bar in 1826, and entered practice at Hillsboro. From 1833 he was repeatedly elected to the House of Commons, of which in 1839-40 he was speaker. In 1840-3 he was in the United States Senate, in 1844 and 1846 was elected Whig governor of North Carolina, declined a third term, and in 1850-2 was secretary of the navy, in which capacity he organized Perry's expedition to Japan. Though at first opposed to secession, he later identified his fortunes with those of

his State, and in 1864 took his seat in the Senate of the Confederacy. Subsequent to the war he was an executor of the Peabody fund for the promotion of education in the South, and a member of the commission for settlement of the undetermined boundary line between Virginia and Maryland.

Graham Land, a tract of land in the Antarctic; discovered in 1832 by Bisco, master of a British sealer. In 1894 Larsen, a Norwegian, reported the discovery of a continent, one portion of which he named King Oscar II. Land and another part Foyne Land. Both proved to be on the coast of Graham Land. The Belgian expedition of 1897–8 explored the west coast, and gave it the name of Palmer Land, in honor of Nathan Palmer, an American sealer, who discovered this coast in 1818. Capt. James Cook (q.v.) reported, in 1774, finding land in the Antarctic, but not a continent.

Grail, The Holy. The cup or bowl from which Christ drank at the Last Supper. The history of the grail as given in most romances is substantially as follows: After the Last Supper the cup came into the possession of Joseph of Arimathea, who caught in it some of the blood that flowed from the wounds of the crucified Saviour. Being miraculously conveyed to England to escape persecution, he carried the precious vessel with him. Throughout his life it furnished him with food and drink, and with spiritual sustenance as well; and at his death he charged his successor to guard it faithfully. It was handed down from generation to generation, the Fisher King being a descendant of Joseph. This vessel is the grail. According to other versions, the grail chooses its own knights. It possesses miraculous properties, and at times is instinct with divine life. To discover its abiding-place and become one of its guardians is the ambition of good and valiant men, but only the pure in heart may find it. One form of the legend represents three of Arthur's knights, Galahad, Perceval, and Bors, as being blessed with a sight of the holy relic. Galahad is said to have had it in his possession, who at his death transferred it to Perceval, and after the death of the latter the cup was taken up into heaven. Students of folk-lore connect Perceval of the Christian legend with the Siegfried of early German literature and Celtic mythology, but the account of a sacred spear and bowl, as given in the grail romances, appears to be mainly of Christian legendary origin, and to be based upon the lives of saints and certain apocryphal books of the New Testament, principally the Gospel of Nicodemus. It is probable that the Perceval story was familiar, in one or more of its many different forms, to the people of western Britain, before their conversion to Christianity. When the French romancers of the 12th century began to develop the grail idea,— the idea of a sacramental symbol, dwelling among men but discoverable only by the brave and pure,— they wove into their narrations tales of chivalry, mysterious adventures, and legends of folk-lore. Chrestien de Troyes, who was possibly the first writer from whom a grail romance has come down to us, was evidently intending to fuse certain elements of the grail and Perceval legends. He began his work about 1189, but died without completing it. Chrestien's poem was taken up by several other French writers after his death. An introduction was fitted to it, in which a violent attempt was made to reconcile the Christian and heathen elements. Many thousands of lines were also added, by various hands, in the early years of the 13th century. Meanwhile, probably before the end of the 12th century, Robert de Borron had written, in Old French verse, a trilogy, 'Joseph,' 'Merlin,' 'Perceval,' of which the 'Joseph' and part of the 'Merlin' have been preserved. It was he especially who gave to all the material a Christian character. There are also later prose adaptations of his work. Great difficulty is occasioned by our ignorance of where to place the French prose romance, the 'Queste del Saint Graal,' generally attributed to Walter Map, or Mapes, and another, the 'Grand Saint Graal,' often accredited to Borron. In these the Christian symbolizing tendency is strong, and the story of Perceval is buried under many complicated tales of knight-errantry. They were, however, probably written before 1204. The 'Queste' having been one of the romances followed by Malory in his 'Morte Arthure,' the Galahad story has had a marked influence upon later literature. There are several other members of the early cycle of grail romances, but only one is of great importance,— the 'Parzival' of Wolfram von Eschenbach. The 'Parzival' is his *magnum opus*. It is also the finest narrative poem of which the authorship is known, between the era of classical antiquity and the 'Divine Comedy' of Dante. Furthermore, it is the most complete, and virtually the final, mediæval handling of the two great themes which are involved in the legend of the holy grail, and which Wolfram more thoroughly blends than any other poet.

During the next 250 years it was the mission of the legend of the holy grail to be the spiritualizing tributary of a broader stream of literature, the full current of Arthurian romance. It then remained in obscurity until the 19th century. Modern English and German poets in reviving the story of the grail, have been moved by the same moral earnestness as Wolfram von Eschenbach, and by the same desire to show the way to seekers after the spiritual life. The best-known of the many modern embodiments of this legend are Tennyson's 'Holy Grail' and the text of Wagner's musical drama 'Parsifal.'

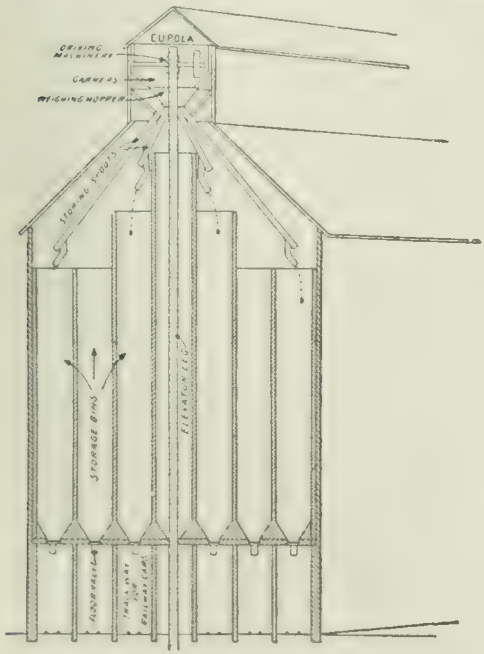
Bibliography.— Baring - Gould, 'Curious Myths of the Middle Ages'; Birch-Hirschfeld, 'Die Sage vom Gral'; Furnival, 'La Queste del Saint Graal'; Gurteen, 'The Arthurian Epic' (1895); Hucher, 'Le Saint Graal' (Paris 1875–9); Heinzel, 'Ueber die französischen Gral-romane' (Vienna 1891); Nutt, 'Studies on the Legend of the Holy Grail'; Rhys, 'Studies in the Arthurian Legend'; Paris (G.) 'La litterature Française au moyen age' (2d ed. Paris 1890).

Grain, any cereal cultivated on account of its seed for the production of meal or flour. All kinds of grain contain nutritious particles of a similar character, although they vary, both in their quantity and in their mixture, in various grains. These elements are: (1) Gluten, which affords the strongest nourishment for the animal body. (2) Fecula or starch, which is very nutritious, although not so much so as gluten, which, however, it seems to render more di-

gestible. (3) A sweet mucilage, which is more nutritious than starch, but is small in quantity, and renders the grain liable to the vinous and acetous fermentation. (4) A digestible, aromatic substance contained in the hulls, which consist of a fibrous matter. (5) Moisture, which is predominant even in the driest grain, and increases the weight of the mass, although it lessens the specific gravity; it affords no nourishment, hastens the decomposition of all kinds of grain, if they are not kept very dry, and influences germination. See articles under names of different cereals.

Grain Elevator, a structure equipped with elevating machinery for the purpose of loading, storing, and cleaning grain which is subsequently unloaded directly into railway cars, canal boats, or grain-carrying vessels for transportation.

It consists of a rectangular building or "house," surmounted by a smaller structure called the "cupola." The house is divided into a series of deep storage bins, while the cupola contains the machinery for operating the "elevator leg," the turnhead spouts, the garners, the weighing machines, and the cleaning machinery. It is usually constructed of timber with brick outside walls for the house, and corrugated sheet iron for the roof and walls



Sectional Diagram of Grain Elevator.

of the cupola. Many elevators, practically fireproof, are built with solid brick walls enclosing steel bins surmounted by steel framed cupolas roofed with terra-cotta or sheet iron, while the bins of some of the European structures are made of steel skeletons embedded in concrete. In the United States further protection is obtained by housing the steel storage bins and the operating machinery in separate fireproof buildings, the grain being handled between them by a system of pneumatic conveyors.

The elevator leg consists of a framing the foot of which extends below the floors of the bins, while its head reaches to the topmost story of the cupola. Within this framing a belt conveyor, made up of several thicknesses of canvas and sheet rubber, usually 36 inches wide and three quarters of an inch thick, is operated by steam power. The belt, which is of the endless type and carries a series of metallic buckets, passes over two pulleys, one at the foot and the other at the head of the leg and lifts the grain to the turnhead spouts in the cupola.

Unloading and storing is accomplished as follows: The grain-laden cars are usually run up along the side of the building so that each car is placed directly under an elevator leg. Two men in each car, operating shovels by ropes from a steam-driven shovel shaft, shovel the grain into the pits of the elevator leg, and thus fill the buckets of the conveyor, which, operating continuously, carries it up to the cupola, where the buckets are tipped over automatically and their contents discharged into the turnhead spouts. From these the grain passes by gravity into the garners, thence into the hoppers of the weighing machines, which are usually gauged exactly for 100 pounds, thence to the cleaners if desirable, and finally through a system of spouts to the storage bins.

When used for unloading grain from ships to railway cars the elevator legs are placed outside the house and their feet lowered into the hold of the vessel through the hatchways. The conveyors carry the grain to the turnhead spouts from which it passes to the storage bins, and thence through the floor valves of the bins to the cars placed beneath them. Under such conditions they are called "marine elevators," and when the arrangement is mounted on a barge or float to permit of its being moved from place to place, it is commonly known as a "floating elevator."

To unload grain from an elevator into the grain-carrying vessels of the Great Lakes, the vessel is made fast alongside of the house, and its hatches being removed, the grain is poured by gravity in a perfect torrent into its hold through great spouts which extend to the hatchways from the floor valves of the bins. The discharging capacity of these spouts ranges from 12,000 to 60,000 bushels per hour, and load vessels of the greatest capacity in two or three hours.

The loading and storing capacities of individual elevators vary greatly according to their location. Innumerable small structures capable of handling only a few thousands of bushels each are located along the lines of railway traversing the grain-bearing regions of the Western States; but those at the large centres of flour manufacture and grain transportation, such as Minneapolis, Duluth, and Chicago, are of mammoth proportions, with individual capacities ranging from 500,000 to 5,000,000 bushels. One of the medium sized elevators at Duluth is 285 feet long, 85 feet wide, and 150 feet high. Nine belt conveyors driven by a 200 horse-power steam engine lift the grain to a height of 145 feet to the turnhead spouts. Each belt carries 125 buckets having a capacity of one peck each, so that the total load at any working instant is about 270 bushels or 15,000 pounds, representing an unloading capacity of 12,000 bushels per

hour. The storage bins are each 60 feet deep by 20 x 10 feet cross section, with a capacity of 12,000 cubic feet, thus giving the elevator a total storing capacity of 1,500,000 bushels.

The cost and rendering of elevator service is fixed and regulated by different conditions in the different States. In Illinois the elevators are compelled to receive and store, up to their full capacity and without discrimination, all the grain brought to them for that purpose, provided it is free from disease or other impurities. The maximum charge allowed for this service is 1¼ cents per bushel for the first 10 days or any portion thereof, and ½ cent per bushel for each subsequent 10-day interval. The elevators at each of the three cities mentioned have a total capacity of about 35,000,000 bushels, and each group handles about 70,000,000 bushels of grain annually.

William Morey, Jr., C.E.,
Consulting Civil and Mechanical Engineer, New York City.

Grain, Handling and Transportation of. The methods of handling the grain produced in the Northwest, the various stages through which it passes from the field to the consumer, the means and appliances employed and incidentally the volume of grain handled, and the cost and method of transportation are important factors in the agricultural development of the Great West.

The States of Minnesota and the Dakotas are the spring wheat States, producing the bulk of that incomparable variety in the United States. The process of seeding and harvesting is much the same with the small farmer with his 160 acres as the large one with his thousands of acres. Both use similar machinery, differing only in the amount used. It is a self-evident fact that in the production of grain and the manufacture of flour, as well as in all other manufacturing industries, the profit depends in a very large degree upon the volume of business done. The tendency in all lines has been to cheapen the cost by increasing the volume.

Minnesota and the Dakotas produce a yearly average of 133,000,000 bushels of wheat, 55,000,000 bushels of corn, 87,000,000 bushels of oats, 1,600,000 bushels of rye, and 22,000,000 bushels of barley. At most towns in these spring wheat States, along the lines of railroads are small elevators, to which the farmer takes his grain either to sell, store, or ship, according to his inclination or ability. These elevators receive the grain for storage or for shipment to the primary or semi-terminal elevators at Minneapolis or Duluth. Well-informed farmers and dealers estimate the cost of production of a bushel of wheat to be from 40 to 45 cents. The average cost of transferring the grain from the farm or initial point of shipment to either Minneapolis or Duluth (rates being about the same) is about 10 cents per bushel. The charges for storing grain at these points are about three fourths of a cent per bushel for the first 15 days, including cleaning.

The average yearly receipts of wheat in round numbers at Minneapolis for the last 12 years were 73,000,000 bushels, of which about 54,000,000 bushels were manufactured into flour. The elevator capacity at Minneapolis is 36,000,000 bushels.

State Inspection.— In Minnesota the State inspection of grain is accomplished by well-qualified men having a technical knowledge of their work and experienced as well, under rules prescribed by the State Board of Appeals. The board of inspection is composed of six members, three of whom are located at Minneapolis and three at Duluth. If the inspector's report is not satisfactory to the buyer or seller, the aggrieved party can appeal to the Appeal Board, whose decision is final. The mode of inspection is as follows: The first step of the inspector is to go with the sealer, who opens the car, breaking the railroad seal for the inspector, who enters the car, and takes several samples of grain by probing to the bottom of a car in several places with an instrument provided for that purpose. From these samples he mixes and makes a general sample, from which his report as to grade under the rules is made. The car is then resealed with a State seal, the railroad seal number and the seal number substituted by the State having been duly recorded by the sealer.

Weighing.— After the cars of grain have been transferred to the elevators, the grain doors are removed, which allows the grain to fall into pits under the cars. The assistant weighers take the number and initial of the car, see that no grain is left in the car and that the shipment has been elevated to the scale floor at the top of the elevator. The grain is then carefully weighed and distributed to the different storage bins of the elevator and, after cleaning, is ready for shipment eastward. The charge for inspecting and weighing a car of grain is 50 cents. The record of every car inspected and weighed is carefully preserved by the two departments, each of which gives to every owner or agent a certificate of grade and weight. These certificates form the basis of settlement of the consignor with the consignee, the freight bills of the railroad companies and supply the necessary information to the grain registrar, whose duties will be more clearly defined hereafter. The State employs a scale expert, whose duty it is to examine and test the scales used at Minneapolis and Duluth, to see that they are in perfect condition at all times.

Grain Registration.— In those elevators termed regular, under the rules of the exchanges at Minneapolis and Duluth, great care is used to prevent any irregularities as to grade and quantity. After the grain has been inspected and weighed as before described, and the elevators have reported to the State registrar, he issues certificates which show the name of the elevator, the date the grain was received, the number and initial of the car, the number of bushels and the grade. These receipts must be returned to the registrar and canceled before the grain can be shipped. The registered receipts are mainly used as collateral upon which to obtain money at the banks, and are considered and approximate as nearly to perfect securities as any found in the West. Many years of experience have proven that this standard of securities has been very high and safe.

Duluth as a Semi-terminal Point.— Duluth is a primary or semi-terminal market, the same as Minneapolis. The system of inspection, weighing and registration is identically the same; but Duluth, being the point where rails and water meet, and being Minnesota's only lake port, the method of shipment of grain is different from that at Minneapolis. The elevator capacity at

Duluth is 34,000,000 bushels, the average receipts of wheat for past 12 years being in round numbers 62,000,000 bushels, of which some 8,000,000 bushels are manufactured into flour at the Duluth-Superior mills. The balance is mostly consumed in eastern markets, although some years a million bushels have been exported.

Water Transportation.— On the Great Lakes large steel freighters carry the products of the prairie farms of the West at greater reduced cost than in years past. The evolution is from the little 100-ton steam-barge of 30 years ago to the 10,000-ton steamer of to-day, and it frequently happens that vessels loading at the elevators at the head of the Lakes, take at one load all the grain grown on a whole township of land.

The question of cheap transportation eastward of the varied and enormous products of the Northwest has been the subject of congressional legislation for many years; and that it was wisely considered by that body is evidenced by the governmental appropriations of over $10,000,000 since 1881 for the purpose of building locks, widening and deepening canals and improving the channel through the river at Sault Ste. Marie. That the full benefit of the improvements at the "Soo" be fully realized to the end that vessels might load to their full capacity, an appropriation was made a few years ago of $3,130,000 for deepening the channels in the joint harbor of Duluth and Superior, to 20 feet, thus enabling vessels trading between Duluth and Buffalo to load to that depth. The benefit of this is shown by the fact that the average size of vessels trading at the head of Lake Superior has grown from 336 tons in 1885 to 1,940 tons in 1902. With economy in production by the aid of improved labor-saving machinery, and larger and better vessels operated at less sums proportionately, it is no wonder that the cost of seeding and harvesting the grain and transporting it to the seaboard has been reduced to the minimum.

Loss in Transit.— The average loss per 1,000 bushels of wheat in transfer from Duluth or Chicago to Buffalo in 1902 was 14 pounds, or about one peck for each 1,000 bushels, showing that the weighing of grain by the large elevators has been reduced to a science. Quick despatch at the Duluth elevators during the season of large receipts is proverbial and it is frequently the case that some of these large vessels load at the rate of 60,000 bushels per hour. The average freight rates on grain from Duluth to Buffalo for the last six years has been 22 mills per bushel. From Buffalo to New York the rates for the same period have averaged about three and one third cents.

With closer trade relations with Canada by removing the duty on wheat, the amount of grain that would find its way east via the Great Lakes would be greatly augmented. About 75 per cent of the grain going east by water from Duluth, goes to Buffalo, 11 per cent to Chicago and Lake Erie ports, and 14 per cent to Canadian ports.

H. B. Moore,
Secretary Duluth Board of Trade.

Grain Insects. Stored grain, corn, nuts, and the like, are frequently infested and injured by various insects. About 40 kinds of weevils (q.v.) lay their eggs upon dry grain, and their grubs bore into and devour the kernel, so that when they are numerous great damage may ensue. It has been estimated that the annual loss in the United States from this cause alone is about $40,000,000. The most important of these pests are the granary-weevil (*Calandra granaria*) and the rice-weevil (*C. oryza*). The former is wingless, evidence that it was domesticated ages ago. It multiplies so rapidly, developing from egg to adult in about six weeks, that five or six generations might be produced annually in a warm temperature. The rice-weevil has well-developed wings, which it seldom uses, showing a strong tendency to become wingless in time. Much injury to stored grain is also caused by other beetles, particularly by three species (*Silvanus surinamensis, Cathartus gemellatus* and *C. advena*), but they usually follow the attacks of other insects. The cadelle (*Tenebroides mauritanicus*) is to be included in this category, as it has a pernicious habit of gnawing into kernels of grain and destroying the embryo or germ. Great harm in granaries is done also by small moths related to the clothes-moth, whose caterpillars bind the grains together, forming clots, which both spoil the edible quality of the cereal, and clog mill machinery. The most familiar of these is the European *Sitotroga cerealella,* often called Angoumois grain-moth, but known as "fly-weevil" in the southern States, where it is so prevalent that grain can nowhere be stored for a long time. Another imported grain-moth, troublesome in the United States since about 1890, is *Ephestia kühinella;* and a third (*Tinea granella*), is especially harmful to wheat in Europe, but not prevalent in America. Injury by the Angoumois grain-moth and the rice-weevil, which obtain entrance to the grain in the fields, can be largely prevented by early harvesting and by threshing as soon as possible. The standard remedy for all grain insects, however, is bisulphid of carbon, applied at the rate of one or two ounces to every hundred pounds of infested grain, which is effective in proportion to the tight closing of the bins. Exposure should last as long as possible, unless the seed is desired for planting, when an exposure of 24 hours is sufficient and will not detract from the germinating power. In buildings that cannot be tightly closed a larger quantity of the insecticide must be used, and repetition of treatment is necessary in warm weather at intervals of six weeks or more. Frequent stirring about of the grain is helpful against these insects; and granaries whenever emptied should be thoroughly cleaned and whitewashed. See Flour and Meal Insects.

Grain-poisoning. See Ergotism.

Graining. (1) In leather manufacture, the process of rubbing leather with a board to raise the grain. The leather having been shaved to a thickness at the beam, and daubed, is hung up to dry, and is then folded, grain side in, and rubbed on the flesh side with a pommel or crippler to give the leather a granular appearance and render it supple. The hide is then extended and rubbed on the grain side. This is termed bruising. Also a process for giving markings to the surface of leather to imitate the wrinkled appearance of morocco, hog-skin, and some other leathers.

(2) In painting, the imitation of the natural grain of wood by means of tools. Combs,

brushes, rollers, and the corner of a folded rag are used in making the various patterns.

(3) In lithography, a mode of giving a certain texture to the face of a stone. One stone is laid on another with a quantity of sifted sand of a given fineness, and by a peculiar oscillation and gradual progression the surface is cut into a set of fine prominences more or less deep and distant, according to the character of the work to be placed on the stone.

Grakle, grăk'l, the name of several kinds of birds. In the United States the blackbirds (especially the larger ones) of the family *Icteridæ.* (See BLACKBIRD.) In India and eastward a myna (q.v.) or some related bird formerly classified in the miscellaneous group *Gracula.*

Gramineæ, grā-mĭn'ẹ-ē. See GRASSES.

Grammar, in its widest sense is the science of language, treating of the words of which language is composed, and their mutual relations when combined in a sentence for the expression of thought. Universal grammar is the science of verbal expression throughout all languages; comparative grammar studies the words and grammatical forms of a group of kindred languages — the Aryan group, for example; a particular grammar deals with the words and grammatical forms of a single language. But the study of words, their meanings, their origins and their histories may be regarded as belonging to lexicography rather than to grammar proper: the proper field of grammar would then be the study of the methods by which the relations between words in a sentence and between sentence and sentence are determined. The English language as it exists differs in important respects from the Germanic dialects from which it is sprung: it has lost great part of its native vocabulary and has taken to itself a very considerable portion of the vocabulary of Latin, either direct from that language or through the French. And its mode of expressing the relations between words has been immensely simplified by eliminating the inflexions which in those early dialects were very numerous. The grammatical rules which regulated English speech in the several stages of its development became antiquated as the change proceeded, and now English is less under control of grammatical rules than perhaps any of the other languages of culture.

Here comes into view the important difference which exists between the languages which express by inflexions the mutual relations of words in a sentence, and the languages which indicate those relations merely by the position of the words. English is the type of a language almost without inflexions: Latin is an example of one that abounds in inflexions. English has but one case inflexion of nouns, the s of the possessive case; and an objective case inflexion of pronouns: he, him; they, them; who, whom, etc. As Marsh observes (Lectures on the English Language, 393) this inflected possessive of nouns expresses in modern English almost exclusively the notion of property or appurtenance and applies to persons or to animated creatures; hence we say «a man's hand,» «a horse's hoof,» but not «the house's roof.» Though the Germanic dialects from which English is sprung had inflexions of adjectives, both for gender and number, no trace of them now remains in English. In Latin, nouns, pronouns, adjectives, verbs, all have numerous inflexions to denote all manner of relations between the words of a sentence. An adjective is of the gender of the noun to which it belongs: Good man is *bonus vir,* good girl, *bona puella,* and these two phrases are in the nominative case plural *boni viri, bonæ puellæ.* Declinable parts of speech in Latin have six cases in singular and plural, viz.: nominative, genitive, dative, accusative, vocative, ablative. The verb in English has but two inflections, the d or ed of the past indefinite or præterite, as, sail, sailed, and the participial inflexion ing. But the Latin verb has four modes, indicative, subjunctive, imperative, infinitive, also present and future participles and the two forms called «supines»: all these in the active voice, and all constituting inflexions. The tenses, each with a distinctive inflexion for the three persons and for singular and plural are the present, imperfect, perfect, pluperfect, future, and future-perfect: not all of these tenses run through all the modes. In the passive voice the perfect, pluperfect, and future-perfect are not inflexional.

English being practically uninflected, position in the sentence determines the mutual relations of the words. In the sentence «Titus teaches Julia the letters,» no different arrangement of the words can be made without rendering the whole unintelligible. But convert the sentence into Latin, and in whatsoever order the words be written, the sense is ever the same: «*Titus Juliam literas docet,*» or «*Literas Juliam docet Titus,*» etc. Again, «Proteus drove his flock to view the high mountains» (mountain tops) — *Proteus pecus egit altos visere montes;* no change of position of the words affects the sense. In passing it may be noted that Horace's phrase, «*pecus egit visere,*» drove (his) flock to see, is in Latin a poetical license, and in prose the idea would be differently expressed: but the phrase in English is grammatically correct both for prose and poetry.

English knows nothing of grammatical gender: in other languages grammatical gender attaches to all nouns, whether distinguished by sex or not. The modern Latinish languages, French, Spanish, and Italian, attribute gender, masculine or feminine, to all nouns; but Latin has also a neuter gender. In Latin *domus* (house) is feminine, *murus* (wall) masculine, *jumentum* (beast of burden) neuter; and of course adjectives qualifying such nouns must agree with them in gender. In English there is a tendency even toward eliminating nouns feminine which designate women as engaged in sundry employments — that of instruction, authorship, etc., and to substitute for instructress, authoress, etc., instructor, author, doctor; so, too, women are masters of arts, bachelors of arts, etc.

The subjunctive mode of verbs in English has gone almost quite out of use. In Latin the subjunctive form possessed very great importance in defining with precision a writer's or a speaker's meaning. A notable peculiarity of English grammar is that it permits a word to serve both as noun and adjective, as when we say a sword thrust, a marble building: such phrases would be rendered into Latin by *gladii ictus* (thrust of sword), *ædificium marmoreum;* rendered literally, they would be unintelligible.

Equally peculiar to the grammar of English is the use of nouns as verbs, as "to shovel snow," "to pen a letter"; or even of proper names, as "to burk," to "boycott"; and "macadamize," might better have been "macadam." English cannot be compared with Latin grammar with regard to the use of the definite article, for Latin has not the article: but when English is compared with other modern European languages, as German, French, Italian, etc., the English article is seen to be a "definite" article indeed. In those languages such words as time, life, humanity, patriotism, always have the article, but in English only when a definite time, life, etc., are in question.

JOSEPH FITZGERALD,
Author of 'Word and Phrase.'

Grammar-schools. See EDUCATION, SECONDARY.

Gramme, grăm, the standard unit of French measures of weight. A gramme = 15.43248 grains troy, from which the equivalents in English measure for the other weights can easily be found; thus:

		Grains Troy		Pounds Avoirdupois
Centigramme	=	.1543234	=	.0000220462
Decigramme	=	1.543234	=	.000220462
GRAMME	=	15.43234	=	.00220462
Decagramme	=	154.3234	=	.0220462
Hectogramme	=	1543.234	=	.220462
Kilogramme	=	15432.34	=	2.20462
Myriagramme	=	154323.4	=	22.0462
Quintal	=	1543234	=	220.462

See METRIC SYSTEM.

Gram'ophone. A sound-reproducing apparatus invented by Emile Berliner. In principle it is similar to the phonograph (q.v.) and the graphophone (q.v.), but differs from these by employing a glass disk coated with lampblack instead of a cylinder of wax for its record. This disk carries a stylus connecting with a diaphragm which is vibrated by the sound-waves, and records those vibrations upon the lampblack surface in the form of a long spiral, as the disk is revolved in a horizontal plane. Unlike the record cylinders of the phonograph or graphophone, the disk cannot be used directly to reproduce the sounds thus recorded, and for that purpose a corresponding disk of hard rubber, prepared from a metal die photo-mechanically etched from the original markings on the lampblack coating of the glass disk is employed.

Gram'pians, Grampian Hills, or **Grampian Mountains.** (1) The mountain system of Scotland, extending across the country from northeast to southwest, for a distance of about 150 miles, and separating the Highlands from the Lowlands. Its limits are not well defined, but it may be said to commence near the southwest end of Loch Awe, on the west coast of Argyleshire, where the main ridge runs, in a well-marked course, along the northern boundaries of Perthshire to Cairn Ealer, where it separates into two distinct branches — one stretching north-northeast on the north side of the Dee, and terminating near Huntly; the other running nearly due east on the south side of that river, and terminating in the neighborhood of Stonehaven. With the exception of Ben Nevis, the Grampians comprise all the highest mountains in Scotland. Among these are Ben Cruachan, 3,689 feet; Ben Lomond, 3,192 feet; Ben Lawers, 3,984 feet; Schichallion, 3,547 feet; Ben Macdhui, 4,296 feet; Cairngorm, 4,084 feet; Cairntoul, 4,241 feet. The more remarkable passes are those of Aberfoyle, Glenshee, and Killiecrankie.

(2) A low range of mountains in the western part of Victoria, in Australia, are called Grampians.

Gram'pus, or **Cowfish,** a genus of porpoises of the family *Delphinidæ*. The species inhabiting the North Atlantic (*Grampus griseus*), reaches a length of about 12 feet. The head is globose, with a slight indication of a beak; the lower jaw shorter than the upper; dorsal fin high and falcate. The upper surfaces of the body are gray in color, the belly grayish white. The body is usually marked with numerous, irregular, light-colored lines which are believed to be due to the attacks of the cuttlefish. The young have the front of the head yellowish white, and six or seven vertical white lines on the sides. There are from 6 to 14 rather large, blunt teeth in the lower jaw, but none in the upper jaw. On the Atlantic coast of North America the grampus occurs singly or in small schools, ranging southward to New Jersey. It also occurs on the coasts of Europe. A closely allied species (*G. Stearnsii*) inhabits the North Pacific, and the genus has been reported from the Cape of Good Hope and New Zealand. The grampus feeds upon cuttlefish, and yields oil of superior quality. The name grampus (from the Italian *gran pesce*, meaning simply "large fish") is applied also to various other cetaceans, and especially to the killer whale (*Orcinus orca*) and to the blackfish (*Globicephala*).

Gran Chaco, grän chä'kō, **El,** a territory of Argentina, Bolivia, and Paraguay, S. A., bounded south and west by Santiago del Estero, and west by Tucuman and Salta. Area, about 275,000 square miles. It is watered by the Vermejo and Pilcomayo and numerous other branches of the Paraguay. In the west it is intersected by spurs of the Andes, and in the east forms extensive plains and marshes, with tracts at times entirely inundated, while in the south are vast sandy deserts, interspersed with salt pools. It is thinly inhabited by Indians, who live chiefly by hunting and fishing. In some parts the forests are extensive, and the vegetation rich. Pop. 10,422.

Granada, gră-nä'da (Sp. grä-nä'dä), (1) An ancient kingdom, subsequently a province of southern Spain, bounded by Andalusia, Murcia, and the Mediterranean. It was part of the Roman province of Boetica, and after the Saracen invasion became an independent Moorish kingdom until it was conquered by Ferdinand and Isabella in 1492, when it became one of the 13 old provinces; it had an area of 11,100 square miles, and since 1833 is divided into the provinces of Granada, Almeria, and Malaga. (2) The modern province, with a coast line of 66 miles on the Mediterranean, has an area of 4,928 square miles. It is picturesquely diversified by mountains and valleys, the chief range being the Sierra Nevada, which attains a maximum altitude of 11,781 feet in the Cerro de Mulhacen, the loftiest summit in Spain. The province watered by the Guadalfeo, the Jenil, and Darro is comparatively fertile and well cultivated; and

abounds in mineral wealth. Pop. (1900) 492,460. The capital is (3) Granada, the ancient metropolis of the Moors. It is romantically situated on the rivers Darro and Jenil, at the foot of the snow-capped Sierra Nevada, which forms a background to the crescent-shaped city, with its terraced streets, turrets, and gilded cupolas rising above each other, the whole crowned by the Alhambra (q.v.), the famous citadel palace of the Moorish rulers. Seen from a distance the city has an imposing appearance, but the interior is in a state of decay, and the streets are narrow, irregular, and dirty. The principal buildings besides the Alhambra are, the Generalife, the royal Moorish summer palace, commanding a magnificent prospect; the cathedral, an irregular but splendid building; the archiepiscopal palace; and the residence of the provincial captain-general. Granada is the seat of a university founded in 1531, of several colleges, a normal school, and a school of art. It has various manufactures of local importance only, such as silks and woolens, leather, paper, hats, etc. Granada was founded by the Moors before 800, near the site of the ancient Illiberis, and from 1036 to 1234 was included in the kingdom of Cordova. In 1235 it became the capital of a new kingdom, and attained almost matchless splendor. In 1491 it remained the last stronghold of the Moors in Spain, and mustered 60,000 men to resist Ferdinand and Isabella. The defense proved unavailing, and the besiegers took possession in 1492. A year later it was made the seat of an archbishopric. The great body of its inhabitants still were Moors, and its prosperity continued almost without diminution till 1610, when it declined with the decree expelling the Moors from Spain. Pop. (1900) 75,900.

Granada, Nicaragua. (1) City, capital of the department of Granada; on Lake Nicaragua. It was founded in 1522 and was formerly the chief town of the republic, but has suffered greatly from the civil wars. It is a trading centre for dyewoods, cacao, gold and silver filigree hand-made ornaments, and hides. Pop. 11,879. (2) The department of Granada lies between the Pacific and Lakes Nicaragua and Managua; area about 2,600 square miles. The Mombacho Mountain, an extinct volcano, is the highest peak.

Granadil'la, the edible fruit of certain tropical species of passion-flowers (q.v.).

Gra'nary, The, an ancient burial ground in Boston, Mass., in Tremont Street. Here are buried Paul Revere, Samuel Adams, John Hancock, Peter Faneuil, Chief Justice Sewall, and several of the old colonial governors of Massachusetts.

Gran'bery, John Cowper, American bishop of the Methodist Episcopal Church South: b. Norfolk, Va., 5 Dec. 1829. Graduated from Randolph-Macon College in 1848, he entered the Methodist ministry in that year, was a chaplain in the Confederate army in 1861–5, and in 1875–82 professor of moral philosophy and practical theology in Vanderbilt University. His publications include: 'Twelve Sermons' (1896) and 'Experience the Crowning Evidence of the Christian Religion' (1900).

Gran'bury, Texas, town, county-seat of Hood County; on the Brazos River, the Fort W. and R. G. R.R. The chief manufactures are flour and farm implements. It has a cotton-gin, and is a trade centre for the products of the surrounding agricultural region. Pop. (1901) 3,773.

Gran'by, Canada, town, in Shefford County in the province of Quebec; about 40 miles southeast of Montreal. It is in an agricultural region, and its manufactures are chiefly for the local trade. Pop. (1901) 3,773.

Granby Token (1737), a private copper coinage issued by John Higley of Granby, Conn., where there were copper mines afterward used as Tory prisons and workshops. The obverse was a deer, with the legend «Value Me as You Please»; Roman numerals III. and crescent. The reverse was three hammers on a triangular field, each surmounted by a crown, and with the legend «I Am Good Copper.»

Grand, Sarah, pseudonym of Frances Elizabeth Clarke, English novelist: b. Ireland. When 16, she married Lieut.-Col. M'Fall, with whom she traveled in India, China and Japan; in 1901 she visited the United States. She has been active in the woman's movement, in England, serving as president of a Society for Woman's Suffrage, and of the Woman's International Progressive Union, and as vice-president of the Scottish Association for the Promotion of Woman's Public Work. Her first novel was 'Ideala,' written at 26, but the first work to give her a wide reputation was 'The Heavenly Twins' (1893). Her other writings include: 'Singularly Deluded'; 'A Domestic Experience'; 'Our Manifold Nature' (1894); 'The Beth Book' (1897); 'The Modern Man and Maid' (1898); 'Babs the Impossible' (1900).

Grand Army of the Republic, a patriotic association, organized in the interest of the surviving representatives of the military and naval forces of the Civil War, the families of those dead, and such objects as they think cognate with these. The membership is of soldiers and sailors of the War, honorably discharged or continuing, and State militia on active duty subject to national call during that time. It was worked up in Illinois in the winter of 1865–6, by Dr. B. F. Stephenson and Rev. W. J. Rudolph, the surgeon and the chaplain of the 14th Illinois Infantry; the first post was organized at Decatur, Ill., 6 April 1866; the first national «encampment» was held at Indianapolis 20 Nov. 1866. Its assigned objects are fraternity, commemoration, and assistance among the above classes; and it has aided in establishing soldiers' homes and memorials, and maintaining and educating soldiers' orphans. It also caused the institution of Memorial Day. It ruled in 1869 that it should not be used for partisan work, nominations, or debates, but naturally it has been a powerful factor in political calculations and the shaping of party conduct regarding both nomination of candidates for office and legislative action. It has also given out strong utterances against restraining liberality in pension legislation, and has used its influence to prevent official restriction in the expenditure of money under such legislation. It has headquarters in Philadelphia, and in 1902 reported 6,416 posts throughout the country, each State being a department with a commander. The membership was 263,745; it had been over 400,000 at

one time. The deaths during the year were 8,299. There is a national council of administration of 45. It holds annual meetings or encampments in the chief cities; the uniform is dark blue with black slouch hat. Its badge is a bronze star hung from a strap and ribbon flag; on the star in relief are a soldier and sailor clasping hands in front of a figure of Liberty, with two freedmen in the foreground, the United States flag on the sides. See WOMAN'S RELIEF CORPS.

Grand Cañon of the Colorado. See COLORADO RIVER; CAÑON; POWELL, JOHN WESLEY.

Grand Falls, or **Colebrooke,** Canada, port of entry, in Victoria County in New Brunswick; on the Saint John River, which is navigable to this point. The falls, which give the name to the place, are about 80 feet in height. Considerable trade is carried on in the agricultural products, and the small game which is abundant in the vicinity. Pop. 1,545.

Grand Falls, a cataract of the Grand River, in Labrador, British America. These falls are in a cañon of the Grand River, 25 miles long and nearly 500 feet deep. About four miles above the falls the river begins a rapid descent of 200 feet to the falls, where the precipice is 320 feet deep and 200 feet wide. Below the falls is another rapid descent of about 300 feet, and then a gradual descent to the ocean. The total descent from the beginning of the first above the falls to the ocean is about 2,000 feet. This cañon was discovered in 1839 by a Hudson Bay Company official named McLean; but no further report being made its existence became a memory until 1891, when it was rediscovered and in 1894 surveyed by the Canadian Geological Survey. (See GRAND RIVER.) Consult 'Report by Canadian Geological Survey.'

Grand Forks, N. Dak., city, county-seat of Grand Forks County; on the Red River of the North and the Red Lake River, and on the Northern P. and the Great N. R.R.'s; about 25 miles west of Crookston and 80 miles north of Fargo. It was settled in 1871 and incorporated in 1881. It is situated in an agricultural and lumbering region. Its chief manufactures are flour, lumber, foundry products, bricks, woolen goods, and steam-boilers. In addition to the trade in its manufactured articles it has a large trade in live stock, wheat, oats, and potatoes. It is the seat of the North Dakota State University, opened in 1884, the Grand Forks College, the Northwestern Normal College, and Saint Bernard's College. The city owns the electric-light plant for street lighting and the waterworks. In the last decade the city increased in population over 50 per cent. Pop. (1900) 7,652.

Grand Gulf, a locality in Mississippi, on the Mississippi River, south of Vicksburg. The Confederate batteries at this place were attacked by the forces under Farragut 31 March 1863, and frequent shelling and bombarding occurred from that time until May 3, when the place surrendered to the land and naval forces under Grant and Porter.

Grand Haven, Mich., a port of entry, city, and county-seat of Ottawa County, on Lake Michigan, at the mouth of Grand River, and on the Detroit, G. H. & M., and the Chicago & W. M. R.R.'s, 110 miles northeast of Chicago. It has an excellent harbor with two lighthouses; there is steamboat connection with the principal lake ports, and a large trade in lumber, grain, flour, leather, etc, is carried on. The city was founded in 1835; it is a summer resort of some popularity, with a noted mineral spring; has municipal waterworks and electric lighting plant, electric street railroads, a public library, and a fine park. Among its educational institutions is Akeley College for Girls. Its industries include the manufacture of lumber, wooden-ware, furniture, refrigerators, machinery, pianos, brass novelties, matches, shoes, barrels, etc.; market gardening is lucratively engaged in and the lake fisheries are important. Pop. (1900) 4,743.

Grand Island, Neb., city, county-seat of Hall County; near the Platte River; on the Burlington & M., the Union P., the Saint J. & G. I. R.R.'s; about 85 miles west of Lincoln and 127 miles southwest of Omaha. The first permanent settlement was made in 1869, and it was incorporated in 1872. It is situated in a fertile agricultural region. The chief manufactures are sugar, beet sugar, flour, canned fruits and vegetables, and brooms. Large repair shops for the Union Pacific Railroad are located here. There is an extensive trade in the manufactured articles, live stock, and wheat. Grand Island contains a number of wholesale establishments and is the distributing centre for a large section of the northwest of Nebraska. The State Soldiers' and Sailors' Home and St. Francis Hospital are located here. It is the seat of Grand Island College, opened in 1892 under the auspices of the Baptist Church, and it has a large free library. The present city charter, of 1901, provides for the election of a mayor every two years and a city council, in whom is vested the government. The city owns the waterworks. Pop. (1900) 7,554.

Grand Junction, Colo., city, county-seat of Mesa County; at the junction of the Grand and Gunnison rivers, on the Colorado and M. and the Denver & R. G. R.R.'s; about 97 miles northwest of Gunnison. It is in the midst of a good farming country, where the land is irrigated. It has a pyritic smelter, and a beet-sugar factory, flour- and lumber-mills. Its trade is chiefly in coal, lumber, bricks, grains, fruits, and vegetables. It is the seat of the Teller Institute, a school for Indian pupils. The waterworks and street car lines are owned by the municipality. Pop. (1900) 3,503.

Grand Jury. See JURY.

Grand Lake, one of the shallow bodies of water in the southern part of Louisiana, about 50 miles long. Its chief inlets are Atchafalaya and Grand rivers, and Lake Vernet. Its outlet is Myrtle Bayou, which flows in Atchafalaya Bay, an arm of the Gulf of Mexico.

Grand Manan, mă-năn', an island at the entrance of the Bay of Fundy, off the coast of Maine. It belongs to Charlotte County, in New Brunswick, Can.; area, about 100 square miles. On the north coast, at Indian Beach, is a settlement of Indians. Fishing is the chief occupation, but the large forests still furnish material for ship-building and some lumber. The island is a favorite summer resort, because

of its climate and abundance of small game. Pop. 2,590.

Grand Prix de Rome, grän prē dė rōm, a prize given annually by the Academy of Fine Arts in Paris to the most successful competitor in painting, music, sculpture, etc. The winners of the prize become the charge of the government for four years and are sent to Rome to reside. See ECOLE DES BEAUX ARTS.

Grand Rapids, Mich., city and county-seat of Kent County, second to Detroit in population and importance, is situated on both sides of Grand River, about 30 miles from Lake Michigan, 152 miles from Detroit, 180 miles from Chicago; lat. 42° 57′ 49.02″ N., lon. 85° 40′ 1.65″ W.

Railroads.—The first railroad into Grand Rapids was the Grand Trunk, from Detroit to Grand Haven, in 1858. Since then have been built the Grand Rapids & Indiana, the Michigan Central, the Lake Shore & Michigan Southern, and the Pere Marquette. These roads radiate in 11 different directions, with through trains to all important Michigan cities, Chicago, Cincinnati, and Toledo. The Grand Rapids & Indiana and the Pere Marquette have extensive shops, the latter established in the past year and representing an investment in land, buildings, and equipment of over $500,000. Two interurban lines run out of the city, the Grand Rapids, Holland & Lake Michigan to Holland and Saugatuck, with South Haven, Saint Joseph, and Chicago future objective points; and the Grand Rapids, Grand Haven & Muskegon. Another line is under contract to be built (1905) to Ionia and thence to Lansing, and lines south to Kalamazoo and north to Rockford are projected.

Industries.—Grand Rapids is the base of supplies and the distributing point for western and northern Michigan. It has large wholesale and jobbing houses in groceries, provisions, clothing, dry goods, millinery, carpets, crockery, drugs, paper, cigars, boots and shoes, knit goods, sporting goods, hardware, mill supplies, and in other lines. The chief industry is the manufacture of furniture (see FURNITURE INDUSTRY), with 38 factories, capital $8,005,713, employing 6,654 hands, and annual product valued at $9,409,097. These statistics are from the special United States census taken in 1904. New York and Chicago in their order exceed Grand Rapids in the volume of their furniture production, but Grand Rapids is the recognized leader in design, finish, and quality. Semi-annually, in January for the spring season, and July for the fall, buyers come here from all parts of the United States and from foreign lands to inspect the new styles and to place orders. The semi-annual visitors number from 800 to 1,000. Between 300 and 400 manufacturers of furniture and kindred lines in other parts of the country semi-annually send their samples here for the buyers to inspect. The outside manufacturers occupy large furniture exposition buildings, built for their use, in the heart of the city. There are four of these exposition buildings, one occupying an entire square, five stories high, and two more are projected.

Other important industries and the value of the annual product are (1904): Flour and grist-mill products, $2,370,787; machinery and foundry, $1,265,298; bread and bakery goods, $1,178,138; lumber and planing-mill, $967,396; carriages and wagons, $494,617; hosiery and knit goods, $590,472; wood ornaments, $419,827; men's clothing, $337,900; tobacco and cigars, $574,726; shirts, $111,625; miscellaneous, $11,802,898. The census shows a total of 389 factories, with $25,915,861 capital, employing 15,707 hands, paying $7,392,748 in wages, using $14,615,176 worth of material, and producing goods valued at $31,032,589. The largest sticky fly-paper and carpet-sweeper factories in the world are located here. Twenty-five per cent of the total United States production of gypsum is from the Grand Rapids quarries.

Fruit-growing.—Grand Rapids is also the centre of the West Michigan fruit belt, which extends along Lake Michigan from Saint Joseph to Traverse City. The 1904 peach crop in Michigan was a partial failure, but 479,000 bushels of peaches were marketed here; also 741,000 bushels of apples; 57,000 bushels of cherries, 52,000 bushels of plums; 8,300 barrels of pears; 200,000 crates of strawberries; 96,000 of blackberries; 91,500 of raspberries, besides large quantities of other fruit. The value of the crop marketed here was estimated at $1,850,280. This does not include the large quantities of fruit purchased from this city as a base in Mason, Oceana, Muskegon, Ottawa, Allegan, and Van Buren counties and shipped direct to the consuming market. With an average crop the peaches marketed here will exceed 1,000,000 bushels. This is also an important winter lettuce centre, Chicago, Cincinnati, Saint Louis, and even New York drawing on the Grand Rapids growers for their supplies. One of the most popular varieties of winter lettuce originated here and is named the Grand Rapids.

Banks.—The city has five national banks, capitalized at $2,300,000, five state banks capitalized at $650,000, and one trust company, $200,000. A sixth state bank, capital $100,000, will begin business early in the summer of 1905. The January 1905 statement showed total loans and discounts, $15,868,050.88; stocks, bonds, and mortgages, $6,495,646.93; commercial deposits, $7,733,544.54; savings and certificate deposits, $11,486,877.91; and total deposits, $21,415,024.93. The bank clearings in 1904 were $101,037,199.30.

Churches, Schools, etc.—All the Christian church denominations are represented with congregations and churches. The bishops of the Grand Rapids Catholic diocese and West Michigan Protestant Episcopal diocese live here. The Catholics have a cathedral. The total value of church property is estimated at $1,500,000. The Catholics hold $455,800; Holland Reformed, $228,100; Methodist Episcopal, $153,900; Congregational, $117,900; Baptist, $110,100; Protestant Episcopal, $100,200; Lutheran, $98,800; Presbyterian, $68,200; and other denominations in smaller amounts.

The Holland Theological Seminary, one of the chief educational institutions of the Holland Reformed Church in America, is located here. The Catholics, Lutherans, and Holland Reformed Churches have parochial schools accommodating about 5,000 pupils.

The city owns one high school and 35 ward schools, estimated in value at $1,510,000, managed by an elective board of education of 24

members and the mayor *ex officio*. A movement is on foot to reduce the board to a smaller body. It is also proposed to build a manual training school to cost $60,000. The school enrolment is about 15,000; the cost of maintenance by direct taxation is about $400,000.

The Ryerson public library, a gift to the city of his birth by Martin A. Ryerson of Chicago, contains 65,000 volumes. It is controlled by an elective board of five members. The museum, under the control of the board of education, occupies property costing $30,000, and is especially strong in natural history specimens.

Public Institutions.— The Michigan Soldiers' Home, maintained by the State, with accommodations for 1,000 veterans and 200 widows, is located three miles north of the city. The Michigan Masonic Home, maintained by the Michigan Grand Lodge of Masons, with 250 inmates, is located three miles east of the city. There are three large hospitals, two orphan asylums, one home for the aged, two refuges for unfortunate women, and several minor philanthropics. The city maintains a hospital and the county has a farm and hospital.

Public Buildings.— The public buildings are city hall, valued at $300,000; court-house, $250,000; federal building and post-office, $350,000; county jail, $50,000; Ryerson public building, $350,000; museum, $30,000; police headquarters, $66,000. A bill was favorably reported in the last Congress appropriating $500,000 for a new government building.

Newspapers, Theatres, etc.— The city has three daily newspapers, *The Grand Rapids Herald* (morning), and *The Press* and *The Post* (evening). The city has four theatres.

Clubs and Societies.— The Peninsular Club with 350 business men members owns a club house in the heart of the city valued with real estate at $150,000. The Lakeside Club with 800 members has a club house at Reeds Lake costing $60,000. The Kent County Club owns 100 acres of land and a $15,000 club house in the north part of the city. The Germans have four club houses and halls; the Irish, the Danish and the Polish each one. The Ladies' Literary Club, the Grand Rapids Woman's Club, the West Side Ladies' Literary Club, and the St. Cecelia (musical) Society, all made up exclusively of women, own club houses. The Ladies' Literary club house, built about 30 years ago, was one of the first of the kind in the country. The Young Men's Christian Association has nearly 1,000 members and owns and occupies a building that cost $60,000. The Grand Rapids board of trade has 1,200 members.

Parks and Resorts.— The city has John Ball Park of 100 acres, the original 40 acres of which was the gift of John Ball; the Antoine Campau Park of five acres, the gift of Martin A. Ryerson; Highland Park of eight acres; Fulton Street Park occupying a square, and numerous small parks. The parks are estimated in value at $350,000. Comstock Park of 100 acres is owned by the West Michigan Fair Association, and if it shall cease to be used for fair purposes the property will revert to the city. Reeds Lake, three miles east of the city, and North Park, near the Soldiers' Home up the river, are popular nearby summer resorts. The Lake Michigan resorts at Saugatuck, Holland, Grand Haven, and Muskegon are one hour away by rail. The northern Michigan resorts are easily accessible.

Public Utilities.— The city owns its own waterworks, with Grand River as a source of supply and 150 miles of mains of all sizes, also owns its own electric lighting plant, garbage burner and market. There are 286 miles of street, of which 173 miles are improved. Of the latter, 7 miles are asphalt, 9 brick on concrete foundations, 4 cedar block on concrete, and 6 macadam. Six bridges owned by the city span the river, one at Bridge Street being of concrete construction, four steel and one wood Commercial lighting is furnished by the Grand Rapids Gas Light Company and Edison Electric Light Company, each having a monopoly in its field. The Grand Rapids Railway Company with 60 miles of track, mostly double, controls the street railways.

Government.— Municipal affairs are conducted by a mayor, elected for a term of two years, and a council of 24 aldermen, two from each ward elected for two-year terms, half retiring each year. The fire and police departments, the health, the poor, and the public works departments are under the control of boards appointed by the mayor. The total bonded indebtedness of the city is $2,203,000, of which $1,025,000 is water, $218,000 schools, and $460,000 street improvements. The property owned by the city is estimated in value at $5,593,483.66, not including the schools, library and museum properties. The expenditures for public improvements in 1904 aggregated $233,846, of which $212,091 was for street improvements and $21,755 for sewers.

History.— In 1828 Louis Campau established an Indian trading station here, and in 1831, after the government survey, made the first entry of land. The first settlers, Joel Guild and family, arrived in June 1833. Grand Rapids was incorporated as a village in 1838 and as a city in 1850.

Population.— (1850), 2,686; (1870), 16,507; (1890), 64,147; (1900), 87,565, and the State census of 1904 gave it 95,718. Thickly settled suburbs will add approximately 10,000.

LEWIS G. STUART,
Managing Editor, 'The Grand Rapids Herald.'

Grand Rapids, Wis., a city and the county-seat of Wood County, on the Wisconsin River, the Wisconsin C., the Chicago, M. & St. P., the Chicago & N., and other railroads, about 70 miles northwest of Oshkosh. The river is spanned by a fine bridge connecting with Centralia, a suburban municipality prior to 1900, when it was incorporated with Grand Rapids. Lumbering and agriculture are the chief occupations of the inhabitants and there are lumber, pulp, paper, and flour mills, manufactures of furniture, foundries and machine shops. In the neighborhood are deposits of kaolin. Pop. (1900) 4,493.

Grand Rapids & Indiana Railway Company. This company, fifth in succession, owning a completed line of railroad starting at Fort Wayne, Ind., running thence northerly through the city of Grand Rapids and the western section of Michigan to the Straits of Mackinac, 366.63 miles main line, with spurs and branches in Michigan, aggregating 413.69 miles, had its inception first in January 1854, at Hart-

ford, Ind., where a company known as Grand Rapids & Indiana Company No. 1 was formed with the idea of building a railroad from Louisville, Ky., to the Michigan pineries, but accomplished nothing more than locating a line from Hartford to the northern State line of Indiana, and also as far as Sturgis, Mich.

In May 1855 the Grand Rapids & Southern Railroad Company was organized in Michigan by the same interests to build a railroad from Grand Rapids to the Indiana State line, and consolidated with the first company in September 1855, forming Grand Rapids & Indiana Company No. 2. Upon this company the State of Michigan, by an act of 14 Feb. 1857, conferred the lands granted to the State by an Act of Congress 3 June 1856, to aid in the construction of a railroad from Grand Rapids to some point on Little Traverse Bay.

In June 1857 the Grand Rapids & Mackinaw Railroad Company and the Grand Rapids & Fort Wayne Railroad Company were created and consolidated, forming Grand Rapids & Indiana Company No. 3.

The first 13 years of the life of this enterprise is replete with failures to construct any portion of its line between Fort Wayne and Grand Rapids. With the aid derived from the bonds voted by the cities of Fort Wayne and Grand Rapids it finally completed in December 1867 the first 20 miles of road from Grand Rapids north to Cedar Springs. As early as 1860 and 1861 the company had made two mortgages, the first to secure $5,000,000 and the second $4,500,000.

On 30 Sept. 1869 a contract was entered into by the Pennsylvania Railroad Company, lessee of the Pittsburgh, Fort Wayne & Chicago Railway, the Continental Improvement Company, and the Grand Rapids & Indiana Railroad Company, for an issue of $8,000,000 seven per cent bonds, secured upon the lands and road, running 30 years from 1 Oct. 1869 — $4,000,000 of which were guaranteed by the Pittsburgh, Fort Wayne & Chicago Railway Company, and $4,000,000 unguaranteed. With part of the proceeds of these bonds and the proceeds of $3,000,000 of debenture bonds, the Continental Improvement Company completed the road from Fort Wayne to Petoskey (Little Traverse Bay) in November 1873. The cost of road and equipment as per settlement contract was $10,848,250.

In June 1871 the Grand Rapids & Indiana Railroad Company took a lease for 99 years of the Cincinnati, Richmond & Fort Wayne Railroad, then building, and which was completed in December 1871, from Richmond, Ind., to Adams (five miles east of Fort Wayne), 86 miles, to be used as an outlet south of Fort Wayne for the traffic of the Grand Rapids & Indiana Railroad.

The Continental Improvement Company, under a contract with the Traverse City Railroad Company, dated December 1871, completed the Traverse City Railroad from Traverse City to Walton Junction, 26 miles, in December 1872, and this road was leased to the Grand Rapids & Indiana Railroad Company for 50 years from January 1883, rental being net earnings, which were guaranteed to equal annual interest on first mortgage bonds, $250,000.

In June 1881 the Grand Rapids, Indiana & Mackinaw Railroad Company was organized in the interest of the Grand Rapids & Indiana Railroad Company for the purpose of extending its road from Bay View to Mackinaw City. This portion of the line was open for operation in July 1882. This company was consolidated with Grand Rapids & Indiana Company (No. 3) in October 1884, under the name of Grand Rapids & Indiana Company (No. 4).

The Bay View, Little Traverse & Mackinaw Railroad Company, line from Bay View to Harbor Springs, Mich., six miles, completed its road in 1882; was sold under foreclosure proceedings in February 1888, and purchased at sale by the Grand Rapids & Indiana Railroad Company, which owned all its stock and bonds.

The Muskegon, Grand Rapids & Indiana Railroad Company was organized in the interest of the Grand Rapids & Indiana Railroad Company in February 1886. The road was completed from Muskegon to Grand Rapids, 37 miles, in December 1886, and leased to the Grand Rapids & Indiana Railroad Company for 99 years from time of its completion, June 1886, rental being net earnings, which were guaranteed by the lessee to be equal to the fixed charges (interest on $750,000 five per cent bonds), and 20 per cent of gross earnings of all business interchanged; but the excess of expenditure over earnings forced the sale under foreclosure 10 June 1896.

A new company was organized as the Grand Rapids & Indiana Railway Company, was incorporated in Indiana and Michigan in July 1896, and commenced operation of the road 1 Aug. 1896, with a capital stock of $6,000,000. Of this, $4,291,000 was exchanged for third mortgage 5 per cent bonds, and $1,500,700 for debts, and also provided for a second mortgage of $5,000,000 (2 per cent first year, 3 per cent two years, and 4 per cent thereafter), of which $3,962,000 were exchanged for second mortgage bonds and certain debts of the old company; the remainder held in treasury for necessary betterments to the property in its then depleted condition.

For the year ending 31 Dec. 1904 the total earnings were $3,302,346, and the operating expenses were $2,680,487, thus showing net earnings for the year of $621,859.

By economical management and wise expenditures for betterments and additions, the company was enabled to make a slight return in the shape of dividends to its shareholders, first in 1900, beginning with 1 per cent and now paying 3 per cent; but is confronted by such hostile legislation in Michigan, both in the reduction of its passenger fares and increased taxation, to such an extent that it is a serious question whether it can continue the small return to those who furnished the capital, so long in advance of its needs, to develop western Michigan and northern Indiana.

W. R. Shelby,
Vice-President G. R. & I. Ry. Co.

Grand Remonstrance, a document of protest against misgovernment, drawn up by the House of Commons on 22 Nov. 1641 and presented to Charles I. of England on 1 Dec. 1641. The causes leading up to this written protest were many, and its passage, by a majority of 11, by the House after a long, stormy debate, was undoubtedly hastened by the outbreak of rebellion in Ireland, and also the absence of the

king, who at the time was in Scotland. The Puritan leaders had become disgusted with the intrigues carried on by the king with the Earl of Montrose, and in this document the grievances were set forth in such a manner that they were in fact an indictment of the whole governmental policy of the king. The imprisonment of members of Parliament without cause, the billeting of soldiers, the high-handed methods of the Star Chamber, High Commission, and the Council of the North, the excessive abuses of the commercial monopolies, and the unwarranted extension of the royal forests, as well as other minor grievances, in all 204 sections, were the points discussed in the manifesto. In it were also asked the appointment of new ministers, and that to a synod of learned divines be given the task of Church reform. King Charles ridiculed the document when it was presented for his consideration; on 10 December gave an indirect reply to the criticisms contained therein in shape of a proclamation on religion; on 23 December answered the petition in an extremely evasive manner; and on 3 Jan. 1642, before the House of Lords, impeached the leaders in the Commons who were most opposed to him, and who had been most instrumental in the passage of the document.

Grand River, a tributary of the Colorado River, which has its rise in the northwestern part of the State of Colorado, in the Rocky Mountains, and flows south by west into the State of Utah to latitude 40° 39', and then almost directly south to 35° 40', where it unites with the Green River (q.v.) to form the Colorado. Its length is almost 400 miles. Its chief tributaries are the Dolores and Gunnison. There are many deep cañons along its course through the mountains, and although much of the valley land is fertile, but few settlements have as yet been made.

Grand River, in the southern part of Iowa, has its source in the central part of Adair County and flows southeast through several counties in Iowa and Missouri, a distance of about 300 miles, into the Missouri River at Brunswick, Mo.

Grand, or **Hamilton River,** in Labrador, is the largest river in this section of British America which flows into the Atlantic Ocean. Part of its course is through a mountainous region, and it is the outlet of several lakes. The Canadian Geological Survey of 1894 gives the first reliable descriptions of this river and the adjacent country. See Grand Falls.

Grand River, in Michigan, has its rise in Jackson County, flows north and west in an irregular course for about one half its distance, then west by north to Lake Michigan. Its whole length is nearly 300 miles, although a direct line from its source to its mouth is only about 100 miles. It is navigable from Grand Haven, at its mouth, to Grand Rapids, a distance of 40 miles.

Grand Traverse Bay, an extension of Lake Michigan projecting into the State of Michigan, and named from Grand Traverse County, by which it is bounded on the south. The southern part of the bay is divided into two arms by Preogenise Point, the western arm being bounded by Leelenaw County and the eastern arm by Antrim County.

Grand Trianon, grän trē-ä-nôṅ, Versailles, France, a one-storied palace of considerable extent, formerly a private residence of the French sovereigns, and originally built for Madame de Maintenon by Louis XIV. The palace is visited for its historic interest; its numerous apartments retain much of the original furniture, and contain several fine modern works of art. It is called the Grand or Great Trianon to distinguish it from the Petit Trianon (q.v.).

Grandledge, Mich., city in Eaton County, on the Grand River and the Pere M. R.R.; 14 miles northwest of Lansing. The manufactures are flour, canned goods, sewer-pipe, furniture, and foundry products; and its trade is in its manufactured articles, and the products of the surrounding agricultural country. Pop. (1900) 2,161.

Grand Old Man, The, a name popularly applied to W. E. Gladstone (q.v.).

Grandpré, gräṅ-prā, Canada, village in King's County, in the province of Nova Scotia; on the Minas Basin. Longfellow's poem, 'Evangeline,' has made famous this village and the country around. In 1613 the French settlers living here were driven from their homes by British soldiers. (See Nova Scotia.) Consult Eaton, 'Acadian Legends and Lyrics.'

Grandville, gräṅ-vēl. See Gerard, Jean I. I.

Granet, grä-nā', **François Marius,** French painter: b. Aix, in Provence, 1775; d. there 21 Nov. 1849. After studying under Constantin and David, in 1802 he went to Rome, spending much of his life there. He gained an enviable reputation as a painter of architectural subjects, though no small number of his works are historical. He was appointed custodian of the paintings in the Louvre in 1826, and upon his death bequeathed his fortune to his native city for the erection and maintenance of a museum there. The most famous of his works are: 'Interieur de l'église des Capuchins à Rome' (1819); 'Englise souterraine d'Assise' (1823); 'Le Tasse visitè dans sa prison par Montaigne'; and 'Prise d'habit au couvent de Saint-Claire à Rome.'

Grange. See Grangers.

Grangemouth, Scotland, city and seaport of southeast Stirlingshire, situated near the confluence of the Carron and Forth rivers, and about three miles northeast of Falkirk. Situated as it is, close to the Firth of Forth, and at the entrance of the Clyde Canal, it is one of the most important of Scottish ports, ranking third in value of imports and exports. The immense docks are 28 acres in extent, the timber basins cover 32 acres, and the total quayage amounts to about 2,300 yards. The principal industries are ship-building and coal-mining, while the manufacture of iron and steel, brick and tile is carried on to a considerable extent. The total value of imports in 1898 was about $13,000,000, an increase from $5,500,000 in 1888; the exports in 1888 were valued at $3,500,000, which in 1898 increased to $11,000,000. The main article exported was coal, and the imports consisted mostly of timber, pig-iron, and iron ore. The

town has a building for its administrative purposes; there are also a public library, a public institute, and a large park. Pop. (1901) 7,968.

Granger, grān'jėr, **Francis,** American politician: b. Suffield, Conn., 1792; d. 1868. He was the son of Gideon Granger (q.v.). Graduated from Yale in 1811, he began the practice of law in 1814, was elected from Ontario County to the State legislature of New York in 1825, was re-elected in 1826, and was a delegate to the Harrisburg (Pa.) Protectionist convention. He was prominent in the anti-Masonic movement of the time. In 1834 he was a leading candidate of the newly organized Whigs for the nomination for governor, and in 1834 and 1838 was elected to Congress, and in 1841 became postmaster-general in President Harrison's cabinet. He sat again in Congress in 1841–2, led the stampede of the Whig convention at Syracuse in 1850, and in 1861 was a member of the Peace convention held at Washington.

Granger, Gideon, American politician: b. Suffield, Conn., 19 July 1767; d. 31 Dec. 1822. He was graduated at Yale College in 1787, and having been admitted to the bar, rose to eminence in his profession, and was elected a member of the legislature of his native State. He had an active part in establishing the Connecticut school fund, and in 1801 President Jefferson appointed him postmaster-general. He retained office during both of Jefferson's terms, and was reappointed by President Madison, whose policy he nevertheless opposed. He was consequently displaced in 1814, soon after Madison's second inauguration. He then removed to Canandaigua, N. Y., and was chosen a member of the senate of New York in 1819. He promoted internal improvements, and gave 1,000 acres to further the construction of the Erie canal.

Granger, Gordon, American soldier: b. New York 1821; d. Santa Fé, N. M., 10 Jan. 1876. He was graduated from the United States Military Academy in 1845, served with distinction in the Mexican war, during the Civil War was appointed, in 1862, to the command of the Army of Kentucky, with rank of major-general of volunteers, was prominent at Chickamauga, commanded a division at Fort Gaines (Ala.) (1864), and the Thirteenth Army corps in the capture of Fort Morgan. Brevetted major-general for the capture of these forts, he was mustered out of the volunteers in 1866; in that year was promoted to be colonel, and afterward was commander of the district of New Mexico.

Granger, James, English writer and print collector: b. Shaston, Dorset, in 1723; d. Shiplake, Oxfordshire, 4 April 1776. After graduating from Christ Church, Oxford, in 1743, he took holy orders and was assigned to the vicarage of Shiplake. After a long pastorate there he went on a tour through Holland, in 1773. He wrote: 'A Biographical History of England . . . with a preface showing the utility of a collection of engraved portraits, etc.' (1769). By 1824 his works had received enough additions to make six volumes. In 1806 the Rev. Mark Noble edited another edition of his works, and since then several editions of his works, together with additions by other authors, have appeared. Two of his sermons were also published, entitled 'An Apology for the Brute Creation' (1772); and 'The Nature and Extent of Industry' (1775).

Granger, Robert Seaman, American soldier: b. Zanesville, Ohio, 24 May 1816; d. Washington, D. C., 25 April 1894. A graduate of the United States Military Academy, he served in the Seminole, Mexican, and Civil wars, and in the last named was brigadier-general of volunteers in 1862–5. During the Civil War he commanded the military district of northern Alabama, in 1864, in the same year defended Decatur against Hood, and in 1865, during the occupation commanded northern Alabama.

Granger Cases (said by Justice Field during the trial to be the popular term outside for the whole group; but only as being in the farmers' interest, not because the Patrons of Husbandry, or any of its lodges as such, had anything to do with them), six cases decided in the United States Supreme Court, October term, 1876, all bearing on the same point and decided on the same principles. They were Munn *v.* Illinois; Chicago, B. & Q. R.R. Co. *v.* Iowa; Peik *v.* Chicago & N. W. R.R. Co.; Chicago, M. & St. P. R.R. Co. *v.* Ackley; Winona & St. P. R.R. Co. *v.* Blake; and Stone *v.* Wisconsin. The first, whose decision ruled the others and was given at much the greatest length, was to test whether the act of the Illinois legislature, 25 April 1871, to regulate public warehouses and the inspection and handling of grain, was constitutional. The case was an extreme one; the act was passed for warehouses only in "cities of over 100,000 people" (Chicago), and was therefore a special discrimination; it laid a host of minute, costly, and laborious impositions on warehousemen and elevator owners, and obliged them to publish daily in the newspapers a table of the charges made the previous year, which must not be increased during the current year — therefore, of course, never, as each year was a canon for the next. The court decided that, according to immemorial common law, the government had a right to regulate the use of property for the public good, and to fix maximum charges for public services of those with whom the public has no choice but to deal. Such regulations were never supposed to deprive private owners of their property, but the devotion of property to a use in which the public has an interest subjects it *pro tanto* to public control. In other words, the public is a partner in public corporations. The forms of law may be changed at the will of the legislative body, so long as they only give new effect to old provisions. And warehouses exclusively within one State may be regulated by State legislation, even though their business involves interstate relations. Justice Field made a powerful dissenting argument, concurred in by Justice Strong, on the ground that the legislature had no right to meddle with private business, and it was simply giving that body the power to confiscate private property, contrary to the Constitution. The railroad cases were all against the power of the States under legislation to enforce maximum transportation rates. The decisions were the same in essence, but the court declined to pronounce that the roads would forfeit their charter if they disobeyed the law, which, nevertheless was not repugnant to the Constitution. The division of the court was

the same; and Justice Field again stated the case for the companies. It was, that the charters of the roads were constitutional, and the right to reasonable compensation was the essential feature of the grant; that what was reasonable was a question for the judges and not the legislature to determine. Such regulation of fares as would take from a company the power to meet its just obligations was illegal, and only the courts could determine the facts; this, therefore, was taking away private property without process of law. Such an interpretation of the limits of legislative power over corporations places them at the mercy of every legislative majority. It makes all business public business, and practically destroys all the guaranties of the Constitution.

Grangers, the popular name for the Patrons of Husbandry, a secret association in the interests of agriculture. In 1866 the government sent O. H. Kelley (on the staff of the Department of Agriculture) to inspect and report on agricultural conditions in the South, and suggest means of improving them; he found them very wretched, and the farmers poor, backward, and disintegrated. Considering organization the first requisite for self-defense, and for securing improved methods and needed legislation, he, with six others, formed in December 1867 the National Grange (Farm) of Patrons of Industry. Only farmers could be members; but their women were admitted both to membership and office. The machinery was like that of other secret societies; the local bodies were called granges, and each State had its State grange. There were four «degrees» in local granges, one in State «Pomona,» and two in national («Flora» and «Ceres»). For the first four years the growth was slow; in 1872 it began to spread rapidly, in a year it had over 10,000 granges, and in 1875 its membership was 1,500,000, distributed through every State in the Union. By its rules the order was to have no part in political work, nominations, or discussions, and as an order it had none, but the members could not be expected to neglect the very object of its existence, and almost immediately they began work against railroad rates and discriminations, trusts, «futures,» oleomargarin, etc., besides forming the chief part of the great movement against hard money (see GREENBACK PARTY) — in all of which their organization, and the consequent bid for their support from political parties, aided them enormously. It is therefore not surprising that «granger» has become a typical adjective for all measures in the supposed interest of the western and southern farmers, or of which they form the chief support, the word having the sanction of the highest court (see GRANGER CASES). The Department of Agriculture as a Cabinet office, the act for founding experiment stations, and the Interstate Commerce Bureau are among the more legitimate fruits of the order; others are the subject of much difference of opinion. It has also done much to form co-operative societies, and attempted to make the grain-elevator system a portion of it. The political element, however, was discrediting the whole movement by its excesses and ill judgment, and finally took separate shape as the Farmers' Alliance and the Populist Party (qq.v.), leaving the diminished Patrons of Husbandry to a useful and growing social and industrial influence. Consult: 'American Annals of Political Science,' Vol. IV.; 'Popular Science Monthly,' Vol. XXXII.

Granite, an unstratified rock, normally consisting of three simple minerals, feldspar, quartz, and mica, or, in Dana's nomenclature, of orthoclase, quartz, and mica. For a long time the universally accepted view which is still the prevalent one, was that it is an «igneous» rock of a «plutonic» type. The difficulty has, however, to be encountered that it is not seen in process of formation on the earth's surface. This has been met by the hypothesis that it originates beneath the surface and under high pressure, produced in most cases by earth, but in some instances by a weight of incumbent water. Like surface volcanic rocks it has been fused and afterward cooled; but it does not, like them, comprehend tuffs and breccias, etc., but assumes a crystalline texture, destitute of pores, or cellular cavities to which gases entangled in lava or any such rock give rise. It is in favor of its igneous origin that it has in many places broken through ordinary sedimentary or metamorphic strata, sending veins through them in various directions. It rarely, however, overtops or caps them, as if coming up molten through a crater it had overflowed them above. Hence the term proposed for it — «underlying» — to distinguish it from the volcanic rocks, called «overlying» rocks. It is of all ages, some granite in the Alps having broken up the strata during Tertiary times. Granite encloses fluid cavities, having in them water, containing chlorides of potassium and sodium, with sulphates of potash, soda, and lime. Granite hills have a peculiar rounded form, with a scanty vegetation. They are easily distinguishable from the flat-topped precipice flanked basaltic hills. Von Buch considers that granitic mountains so much tend to be portions of a sphere, that he looks upon them as ellipsoidal bubbles, which were forced upward only in a partially fluid state; then, when the upper dome-shaped surface contracted, many granitic blocks were formed. Granite is of much economic value as a building stone. The production of granite in the United States in 1900 was valued at $12,675,617. The leading States in its production were Maine, Massachusetts, Vermont, and Delaware. See GEOLOGY; STONE.

Granite State, The, the popular name of New Hampshire. Fine building granite is quarried at many points, notably at Plymouth Concord, Milford, Pelham, etc.

Grant, SIR **Alexander,** English educator: b. New York 13 Sept. 1826; d. Edinburgh 30 Nov. 1884. He went to India in 1859, and in 1862 became principal of the Elphinstone College, Madras, and in 1863 was made vice-chancellor of Bombay University. In 1868 he returned to Scotland to become principal of the University of Edinburgh, a position which he held till his death. He wrote: 'Story of the University of Edinburgh' (1883); and annotated and edited Aristotle's 'Ethics' and Xenophon.

Grant, Frederick Dent, American soldier: b. St. Louis, Mo., 30 May 1850. The eldest son of Gen. Ulysses S. Grant (q.v.), he was graduated from the United States Military Academy in 1871, was assigned to the 4th cavalry, was aide-de-camp to Sheridan in the latter's Indian

campaigns, in 1874 served in the Black Hills expedition, and in 1881 resigned from the army with rank of colonel. Later in business at New York, he was minister to Austria in 1888–93, and a police commissioner of New York in 1897 during the Strong administration. At the outbreak of the Spanish-American war (1898) he became colonel of the 144th New York volunteers, was in the same year appointed brigadier-general of volunteers, served for a year in Porto Rico, and subsequently commanded the military district of San Juan. He was also stationed in the Philippines, and appointed brigadier-general in the regular service in 1901.

Grant, James Augustus, British soldier and explorer: b. Nairn, Scotland, 1827; d. there 11 Feb. 1892. He accompanied Capt. Speke in his search for the sources of the Nile (1860–3), when they explored the Victoria Nyanza and were rewarded by the discovery of the river issuing from the north of the lake. This expedition was described in a volume entitled 'A Walk Across Africa' (1874).

Grant, Robert, American author and judge: b. Boston, Mass., 24 Jan. 1852. He was graduated from Harvard in 1873 and the Harvard Law School in 1879, and has practised law in his native city since 1879. He was one of the water commissioners of Boston 1888–93, and in the latter year became a judge of probate and insolvency for Suffolk County, Mass. He has published: 'The Little Tin Gods on Wheels' (1879); 'Confessions of a Frivolous Girl' (1880); 'The Lambs,' verse (1882); 'An Average Man' (883); 'Face to Face' (1886); 'Jack Hall' (1887); 'Jack in the Bush' (1888); 'The Reflections of a Married Man' (1892); 'The Opinions of a Philosopher' (1893); 'The Art of Living' (1895); 'The Bachelor's Christmas' (1895); 'Search Light Letters' (1899); 'Unleavened Bread,' a novel which has been widely read (1900).

Grant, Ulysses Simpson, American general and 18th President of the United States: b. 27 April 1822, in a small two-room cabin situated in Point Pleasant, a village in southern Ohio, about 40 miles above Cincinnati; d. Mt. McGregor, N. Y., 23 July 1885. His father, Jesse R. Grant, was a powerful, alert, and resolute man, ready of speech and of fair education for the time. Ulysses Grant grew to be a sturdy, self-reliant boy. He loved horses, and became a remarkable rider and teamster at a very early age. At the age of 17 he was a fair scholar for his opportunities, and his ambitious father procured for him an appointment to the Military Academy at West Point.

His record at West Point was a good one in mathematics and fair in most of his studies. He graduated at about the middle of his class, which numbered 39. He asked to be assigned to cavalry duty, but was brevetted second lieutenant of the 4th infantry, and ordered to Jefferson Barracks, near St. Louis. Here he remained till the spring of 1844, when his regiment was ordered to a point on the southwestern frontier, near the present town of Natchitoches, La. Here he remained till May 1845, when the Mexican War opened, and for the next three years he served with his regiment in every battle except Buena Vista. He was twice promoted for gallant conduct, and demonstrated his great coolness, resource, and bravery under the hottest fire. He was regimental quartermaster much of the time, and might honorably have kept out of battle, but contrived to be in the forefront with his command.

He was regimental quartermaster at Fort Vancouver, near Portland, Oregon, for one year. In 1853 he was promoted to a captaincy and ordered to Fort Humboldt, near Eureka in California. In 1854, becoming disheartened by the never-ending vista of barrack life, and despairing of being able to have his wife and children with him, he sent in his resignation, to take effect 31 July 1854 and returned to St. Louis.

His father-in-law, Frederick Dent, who lived about 10 miles out of St. Louis, set aside some 60 or 80 acres of land for his use, and thereon he built with his own hands a log cabin, which he called «Hardscrabble.» For nearly four years he lived the life of a farmer. He plowed, hoed, cleared the land, hauled wood and props to the mines, and endured all the hardships and privations of a small farmer.

In the spring of 1860, despairing of getting a foothold in St. Louis, he removed to Galena, Ill., where his father had established a leather store, a branch of his tannery in Covington, Ky. When Galena held a war meeting to raise a company, Capt. Grant, because of his military experience, was made president of the meeting, and afterward was offered the captaincy of the company, which he refused, saying: «I have been a captain in the regular army. I am fitted to command a regiment.»

He wrote at once a patriotic letter to his father-in-law, wherein he said: «I foresee the doom of slavery.» He accompanied the company to Springfield, where his military experience was needed. He mustered in several regiments, among them the 7th Congressional Regiment at Mattoon. He made such an impression on this regiment that they named their camp in his honor, and about the middle of June sent a delegation of officers to ask that he be made colonel. Col. Grant marched his men overland, being the first commander of the State to decline railway transportation. His efficiency soon appeared, and he was given the command of all the troops in and about Mexico, Mo. At this point he received a despatch from E. B. Washburne, congressman for his district, that President Lincoln had made him brigadier-general.

In February 1862, with an army of 20,000 men and accompanied by Commander Foote's flotilla, he took Fort Henry and marched on Fort Donelson. On the 16th of the same month he had invested Donelson and had beaten the enemy within their works. Gen. Simon Buckner, his old classmate and comrade, was in command. He wrote to Grant, asking for commissioners to agree upon terms. Grant replied: «No terms except an unconditional and immediate surrender can be accepted. I propose to move immediately upon your works.» Buckner surrendered, and Grant's sturdy words flamed over the land, making him «Unconditional Surrender Grant.» On 6 April the Federals at Shiloh or Pittsburg Landing were attacked by a large Confederate force commanded by Gen. A. S. Johnston, and beaten back to the Tennessee with heavy loss. Grant, having reformed his lines and been reinforced by Buell, renewed the battle on the 7th, and the Confederates, who, Johnston having been killed, were commanded

ULYSSES SIMPSON GRANT,

EIGHTEENTH PRESIDENT OF THE UNITED STATES.

by Beauregard, were driven from the field. In January 1863 Grant began to assemble his troops to attack Vicksburg, but high water kept him inactive till the following April. Corinth was occupied on 30 May and on 3 July Pemberton at Vicksburg surrendered the largest body of troops ever captured on this continent up to that time, and Grant became the "man of destiny" of the army.

He was made commander of all the armies of the Mississippi, and proceeded to Chattanooga to rescue Rosecrans and his beleaguered army. In a series of swift and dramatic battles he captured Lookout Mountain and Missionary Ridge. The victory at Chattanooga opened the way for Sherman's march into Georgia, and practically closed the war so far as the West was concerned. In February 1864 Congress created and conferred upon Gen. Grant the rank of lieutenant-general, and the following month he assumed command of the armies of the United States, and immediately put himself in position against the army of northern Virginia commanded by Gen. Robert E. Lee. In the bloody campaign that followed (See WILDERNESS, THE BATTLE OF THE) slowly and inexorably Grant forced Lee and his army back upon Richmond. Petersburg fell on 2 April, and Richmond on 3 April; on 9 April 1865 Lee surrendered at Appomattox, and, Sherman having consummated his victorious march to the sea, the war was ended. Grant's terms with the captured general and the Southern army were so generous as to win the respect and admiration of the Southern people. Grant now returned to Washington. In 1866 he was promoted to the rank of general and every honor possible was bestowed upon him. In August 1867, Gen. Grant consented to fill the office of secretary of war *ad interim*, but, the Senate having refused to approve the suspension, January 1868 he surrendered the office to Mr. Stanton.

He was the chief citizen of the Republic at the close of the war, and when Lincoln was assassinated he was the mainstay of the Republic. He became inevitably a candidate for President, and was elected with great enthusiasm in 1868. In 1872 he was re-elected, and during his two terms his one great purpose was to reconstruct the nation. In 1878, two years after his second term had ended, he went on a trip around the world, visiting all the great courts and kings of the leading nations.

In 1880 he was defeated as candidate for nomination for a third term. Shortly after this he moved to New York, and became a nominal partner in the firm of Grant & Ward. His name was used in the business; he had little connection with it, for he was growing old and failing in health. In May 1884, through the rascality of his partner, Ferdinand Ward, the firm failed, and Gen. Grant lost every dollar he owned.

Now came the most heroic year of his life. Suffering almost ceaseless pain, with the death shadow on him, he sat down to write his autobiography for the benefit of his wife. He complained not at all, and allowed nothing to stand in the way of his work. He wrote on steadily, up to the very day of his death, long after the power of speech was gone, revising his proofs, correcting his judgments of commanders as new evidence arose, and in the end producing a book which was a marvel of simple sincerity and modesty of statement and of transparent clarity of style. It took rank at once as one of the great martial biographies of the world.

At his grave the North and South stood side by side in friendship, and the great captains of opposing armies walked shoulder to shoulder, bearing his body to its final rest on the bank of the Hudson River. The world knew his faults, his mistakes, and his weaknesses; but they were all forgotten in the memory of his great deeds as a warrior, and of his gentleness, modesty, candor, and purity as a man. Since then it becomes increasingly more evident that he is to take his place as one of three or four figures of the first class in our national history. He was a man of action, and his deeds were of the kind which mark epochs in history.

Grant University, a coeducational institution in Chattanooga, Tenn., with departments in Athens, Tenn., founded in 1867, under the auspices of the Methodist Episcopal Church; reported at the close of 1900: Professors and instructors, 65; students, 781; volumes in the library, 6,000.

Grants Pass, Ore., city, county-seat of Josephine County; on the Rogue River and on the Southern P. R.R.; in the southeastern part of the State, about 60 miles from the Pacific. It is the commercial centre of an agricultural, lumbering, and mining region; and its chief manufactures are lumber, flour, wood products, machinery for the farms, mines, and for lumbering, and bricks. It has large railroad repair shops. Pop. (1900) 2,290.

Granula'tion Tissue, the tissue formed in wounds to repair loss of substance. Through the clot in a fresh wound certain cells of the blood wander and begin to form new tissue. Blood vessels in tiny loops pass out from the sides of the wound. On the surface these loops form small rounded elevations, spoken of as "granulations." As the process goes on, the new tissue contracts, drawing in the sides of the wound; the skin grows out in delicate points from the margins of the cut. If the granulations pass beyond the surface-line because of irritation, they are spoken of as "superfluous" granulations or "proud flesh."

Gran'ville, Granville George Leveson-Gower, 2D EARL, English statesman: b. London 11 May 1815; d. there 31 March 1891. He was educated at Eton and Oxford; entered Parliament in 1836 for Morpeth, afterward for Lichfield, both in the Liberal interest. In 1855 he became president of the council, and ministerial leader of the House of Lords (1855–8). From 1859 to 1866 he was again president of the council, having previously failed to form a ministry under himself as premier. In 1868 he was colonial secretary under Gladstone, and in 1870 succeeded to the secretaryship for foreign affairs, which he held until 1874. During this period he negotiated the Treaty of 1870, guaranteeing the independence of Belgium, and "protested" against the Russian repudiation of the Black Sea clause of the Treaty of Paris. On the return of Gladstone to office in 1880 he was foreign secretary until 1885.

Granville, N. Y., village, in Washington County; on the Delaware & H. R.R.; about 37 miles northeast of Saratoga Springs and 57 miles northeast of Troy. The village is in an agricultural section, but nearby are valuable slate and building-stone quarries. The slate is

used for mantels, roofing, and marbleized slating. The trade of the town is in stone and slate from the quarries, butter, cheese, hay, and vegetables. Population of the township of Granville, which includes several small villages, (1900), 5,217; of the village of Granville (1900), 2,700.

Granville, Ohio, a village in Licking County, on Raccoon Creek, and on the Toledo & O. C. R.R., about 25 miles northeast of Columbus. It has agricultural and manufacturing interests, but is chiefly noted for its educational institutions, which include Denison University (Baptist), and the Shepardson College for Women. Pop. (1900) 1,425.

Grape Culture. The grape is believed to be the oldest of our cultivated fruits. Although some 1,500 varieties of grapes are cultivated in Europe, they are practically all from a single species of the vine, known as the *Vitis vinifera.* It is supposed to have been indigenous to Asia, where it was widely planted by different peoples centuries before it was introduced into Europe. The Phœnicians have the credit of introducing the culture of the vine into Europe, first into the islands of the Grecian Archipelago and thence into Greece and Italy. The Romans carried vine culture, as a part of their civilization, wherever they settled. Thus, the vine had become well rooted in the south of France, in the neighborhood of Marseilles, at the beginning of the present era. Its culture during the next 200 years spread northward.

The native grapes of America are of entirely different types from the European kinds. The reason is that they come from different species of vines. So that in America, we cultivate two distinct types of grapes: (1) the native varieties, which are indigenous to the country; and (2) the vinifera, or European kinds, which have been transplanted here, and thrive out-doors only on the Pacific coast.

The vine and its cultivation engaged the attention of early colonists, who were encouraged by the authorities and by the lawmakers. The Virginia Assembly passed an act awarding premiums to successful grape growers. When the second charter was granted to Rhode Island by Charles II. in 1663 it contained an inducement to anyone who would plant a vineyard. Queen Christina in her instructions to John Printz, governor of New Sweden, urged that vine growing be encouraged, and she instructed the governor to give the matter his personal attention.

Many of the immigrants to the different colonies came from noted vineyard districts of the Old World. It was only natural that they should try to introduce here the cultivation of those European vines with which they were most familiar. Thus, most of the early attempts to establish vineyards for profit were by foreign, or foreign-born settlers. In 1792 or 1793 Pierre Legaux, a Frenchman, interested a number of Philadelphia gentlemen in his enterprise, and a company was incorporated for the purpose of planting vines. A vineyard was set out at Springmill, near Philadelphia, on the Schuylkill River. Foreign varieties of grapes were tried, but the experiment proved a failure.

About the same period (1790–3) a colony of Swiss grape growers from about Lake Geneva raised a fund of $10,000 and vineyards were planted in Jessamine County, Ky. Foreign varieties of grapes were tried, as had been done previously, but they all ran out and perished. Some years later, or about 1802, certain members of the Swiss colony removed to a place which they called New Switzerland (now Vevay, Indiana), on the Ohio River, 45 miles below Cincinnati. After failing with the best grapes imported from Switzerland, they tried a native variety called the "Cape," or the "Alexander" grape, and they then met with some success. This was largely due to the skill and experience of one member, John James Dufour, who joined the colony about 1805. He was an intelligent and observing vine-dresser, and afterward wrote a small treatise on grape culture and wine making — one of the first books on the subject published in this country. Dufour produced wine, which had a fair sale in the West, but by 1835 or 1840 the wines of Vevay were little heard of, and a few years later the vineyards had nearly disappeared.

Such, in brief, were the leading attempts to introduce the cultivation of European grapes into the Eastern States, beginning in 1620; not one lasting success is recorded.

However, in 1851 the European grape was being grown with success about the different missions. The popular variety was a kind now known as the "Mission grape," which is extensively cultivated in Southern California to this day. Other and better of almost all the leading varieties of European vines have been planted in that State, and their cultivation was a success from the beginning. Our native grapes grow there also, but they are not cultivated to any extent west of the Rocky Mountains. Therefore, grape culture, especially in California, constitutes a separate chapter in American viticulture.

The Cultivation of American Grapes.— After experience had shown that European varieties of grapes would not thrive, practical horticulturists began to turn their attention to the native vines found growing wild, or partially cultivated. They saw that success lay in that direction. But the trouble was to obtain a native grape of superior quality for the table and for wine.

In 1819 Maj. John Adlum noticed a vine growing in a garden at Georgetown, D. C. The grape struck him as having many excellent qualities. He first supposed it to be a European variety, but the grape was really a native of North Carolina, where it was discovered in 1802, and it took its name from the Catawba River. Maj. Adlum was enthusiastic in his estimate of the value of the Catawba grape. In a letter, written shortly before his death to the Hon. Nicholas Longworth of Cincinnati, Ohio, he says: "I have done my country a greater benefit in introducing this grape than I would have done if I had paid the national debt."

There is no doubt that the Catawba grape has played an important part in the grape and wine industry of the United States. This was largely due to the heroic efforts of Nicholas Longworth, who is called "the father of American grape culture." He spent 40 years or more of his life and $200,000 in establishing vineyards in the Ohio Valley, and his wine cellars at Cincinnati, Ohio. His persistent effort to make the industry a success is a fine example of American energy and enterprise. Longworth

obtained thousands of vines from Bordeaux and Burgundy, from the Rhine district of Germany, from Madeira (6,000 vines), and from the Jura (7,000 vines) in hopes of finding grapes which would thrive in his Ohio vineyards. He also tried native grapes, but most of these were given up for the Catawba, which he first received from Maj. Adlum in 1825.

Not only as a pioneer, but as a leader in grape and wine growing, Longworth exercised great influence on the industry. Many able and practical men in Cincinnati became interested in grape culture and, in 1848, the Cincinnati Horticultural Society estimated that within 20 miles of the city more than 1,200 acres were planted in vineyards. During the next three or four years, some six or eight wine cellars were established at Cincinnati. Longworth had two. At his cellars dry and sweet wines were made, and "sparkling Catawba"— the latter produced by fermentation in the bottle after the method of French champagne. It was after a visit to Mr. Longworth that the poet Longfellow wrote his celebrated poem on 'Catawba Wine.'

In 1858, Erskine made a report to the British government on the extent and condition of viticulture in the United States. He gave the vineyard area of the several States, as follows: 3,000 acres in Ohio; 1,000 in Indiana; 500 in Kentucky; 500 each in Missouri and Illinois; 300 in South Carolina; 200 in North Carolina; 100 in Georgia — a total of 5,600 acres of vineyard in the United States. Even at this time grape culture in the Ohio Valley was on the decline. The vines there were being steadily destroyed by mildew and rot. By 1865, these vineyards, which promised so much pleasure and profit, and on which so much labor and money had been expended, were disappearing, and a few years later the grape and wine industry of the Ohio Valley became a thing of the past.

At that time the methods of successfully treating the two principal fungus diseases of the native vine — mildew and black rot — were not known to our viticulturists. Later on the discovery was made that black rot may be kept almost under control by a preparation of sulphate of copper, called the "Bordeaux mixture"— the cheapest and best fungicide ever introduced. As black rot prevailed from an early date in all the vineyards east of the Rocky Mountains, it was only after an efficient remedy was found that grape culture could become commercially profitable in the various eastern States. In California, on the other hand, the vineyards were rather free from fungus diseases, but there, as in France, the phylloxera began its ravages about in 1875, and has been the worst scourge of the vineyards on the Pacific coast since then.

The Growth of Grape Culture in the Eastern States.— About 1865 the grape-growing industry became rooted in the Hudson River Valley, the lake regions of central and western New York, and in northern Ohio, and on the islands in Lake Erie. New York, Ohio, and Missouri are the leading States in the order named. Then come Virginia, North Carolina, Indiana, Illinois, and Kansas. There are small vineyard districts comprising from 500 to 1,500 acres in Georgia, Florida, New Jersey, Michigan, Kansas, Tennessee, and many other States.

The grape industry of the Hudson River Valley was fairly established in the early sixties. Here, the Isabella grape was the leading variety. Like the Catawba, the Isabella is regarded as a native of North Carolina. About 1810 a vine was sent from the South to Col. George Gibbs, who planted it in his garden at Brooklyn, N. Y. A few years later, one of the successful pioneer viticulturists of this country, William Prince, of Long Island, N. Y., introduced this variety to growers, and he named it the "Isabella" in honor of Mrs. Isabella Gibbs. For a long time the Isabella was the standard grape in the New York vineyards, but of late years it has given place to other varieties.

Several varieties of grapes of good quality originated in the Hudson River district. Perhaps the most desirable kinds were the Iona, and the Eumelan. The former was originated by Dr. C. W. Grant, of Iona Island, N. Y. With the Delaware it is considered one of the finest flavored grapes of American origin. The Eumelan is more for wine making than for eating. The vineyards of the Hudson River district in 1890 comprised about 13,000 acres. Since then the industry has gone backward, and at the present time the vineyard area is estimated at from 8,000 to 9,000 acres. There are one or two wine cellars in this district, but about 80 or 90 per cent of the grapes raised along the Hudson River are sold for table purposes.

The Lake Keuka District.— Small plantings of vines were made at Hammondsport, N. Y., at the head of Lake Keuka, from 1850 to 1860. But it was not until after 1865 that the grape industry there began to assume some commercial importance. In 1890, when the statistics of viticulture were gathered for the first time in the United States, there were more than 12,000 acres of bearing vines in the Lake Keuka district, and the growers shipped 20,000 tons, or 40,000,000 pounds, of table grapes to market annually. In addition to that amount, some 5,000 tons of grapes were sold to the local wine cellars. The vineyard acreage in this section did not continue to increase so fast, and in 1903 there were in the district 15,000 acres of vines.

The vintage begins usually the first week in September, when the early varieties (such as the Concords and Delawares) ripen. It lasts until the middle of October, when the last of the Catawbas are gathered. The crop is picked in boxes, which hold from 35 to 40 pounds. The clusters of fruit are cut from the vines by grape shears. When the boxes are filled they are carried to the end of the rows, where they are gathered two or three times a day and taken to the packing-house. Here the grapes are sorted, and packed in 5- and 10-pound baskets. This work is done mostly by women and girls.

The bulk of the grape crop is shipped by fast freight to the large city markets — to New York, Boston, Philadelphia. Within the past few years new markets have been opened in the Far West, and now it is common to find New York State grapes for sale in Denver, Omaha, Kansas City, and even in Manitoba. The experiment was tried of shipping grapes to England, but while the fruit arrived there in fair condition, the cost and prices received did not warrant making further efforts.

The Lake Keuka grape growers now have a long range of season — that is, they can supply table grapes from early in September till the fol-

lowing March and April. The early varieties cannot be held very long, but the Catawba, for example, which ripens late, is a «good keeper.» The grapes are stored in crates or trays in a cool building or cellar, and by proper ventilation and by maintaining an even temperature they can be kept fresh and fair till spring. Some years ago the only grapes in market in mid-winter were hothouse grapes, which cost from 50 cents to $1.50 a pound. Now these outdoor-grown grapes can readily be bought in January or February at 5 and 10 cents a pound.

The wine industry has also made striking progress in the Lake Keuka district. From the 2 or 3 cellars the number has increased to 12 at or near Hammondsport, N. Y. This section of New York State is often called «the American champagne district,» as it produces about two thirds of all the champagne made in the United States.

There are two important areas of vineyards adjoining the Keuka district, namely, the Seneca Lake district of about 5,000 acres of vines in Seneca and Schuyler counties; the Canandaigua district of about 3,000 acres of vineyard bordering on Canandaigua Lake.

The Chautauqua Grape Belt.— This is the greatest single strip of vineyard in the United States. It stretches from the hills surrounding Chautauqua Lake in western New York, along the shore of Lake Erie for some 50 miles. There are about 25,000 acres of vineyard in this belt. The growth of grape culture in the Chautauqua district was remarkably rapid. The industry began about 1860. It grew and prospered, and in 1900 the Chautauqua grape belt contained about 25,000 acres of vines. The annual yield of this district is about 4,000 carloads of grapes. Each car holds from 2,300 to 2,500 baskets. In addition, probably one third, or more, of this amount is used to make wine. The making of unfermented grape juice has become quite a large and growing industry in the Chautauqua district.

The bulk of the crop (about 80 per cent) is handled by an association of growers. The grapes are graded according to their quality, and the returns from the shipments are «pooled.» Each grower gets his pro rata share, after deducting expenses. About 85 per cent of the grapes grown in the Chautauqua belt are of the Concord variety.

The Northern Ohio Vineyards.— Soon after the decay of grape culture in the Ohio River Valley, about Cincinnati, the industry became established in northern Ohio along Lake Erie. Here, the Catawba grape, which was destroyed by fungus diseases in the former locality, survived and soon became the leading variety. There are large stretches of vineyards all along the Lake Erie shore from Ashtabula to Sandusky. There are also several islands in Lake Erie covered with vines; of which Kelley's Island and Middle Bass Island are the best known. The total area of these vineyards in northern Ohio is estimated at from 8,000 to 10,000 acres. From several towns in the northern tier of counties in Ohio, large quantities of table grapes are shipped, principally to western markets. The average crop from the Euclid or Cleveland district has been about 1,500 carloads. The yield about Sandusky and on the Lake Erie islands is mostly taken by the wine cellars.

Summary.— In the districts above described, the growing of grapes (both for the table and for wine making) is regarded as the chief industry. There are considerable vineyard areas in several of the southern and of the western States, and these may become important in the near future. New sections are being planted to vines from time to time; for example, of late years there has been quite an increase of vineyards in southern Michigan, and in the Ozark Mountain region of Arkansas and of southwestern Missouri.

Of American grape culture east of the Rocky Mountains two things may here be noted: First, although some 800 varieties are grown and flourish, yet the bulk of the crop in the leading districts consists of only two or three varieties, namely — the Concord, Catawba, and Delaware; secondly, two thirds of the grapes raised in the East are sold and used for table purposes, while only one third of the crop is made into wine. It is just the reverse in California, for there two thirds of the grape crop is turned into wine, the balance being used for raisins and the table. Therefore, not only in the fact that practically all of the grapes are foreign or European varieties, but in making wine the leading product of the vineyard crop in California is sharply defined from the industry east of the Rocky Mountains.

Grape Culture on the Pacific Coast.— Mention has already been made of the Spanish Fathers, who planted small patches of vineyards about their missions in southern California as early as 1770. The first plantings were at the mission of San Gabriel, and in the course of the next 75 years there were vineyards of from 5 to 25 acres extending from San Diego north as far as Sonoma County. The missions were abolished and their property confiscated in 1845.

The early settlers who began pouring into California in 1849 were more interested in gold than in grapes, and it was not until the year 1858 that a genuine and widespread interest in grape growing arose in the new State. During the next three or four years many vineyards were planted, and the industry began to attract considerable attention, so much so that, in 1861, Gov. Downey was authorized by the legislature to appoint three commissioners «to report upon the best means and ways to promote the improvement and culture of the grape vine in California.» One of the commissioners appointed was Col. Agoston Haraszthy, who, by his writings and his efforts, was largely responsible for this renewed interest in grape culture. He went to Europe, visited the leading vineyard districts there, and secured 100,000 vines embracing 1,400 varieties. These vines and cuttings were distributed from time to time in small lots to growers in different parts of California, and they formed a basis for the viticultural industry in that State.

The first, or experimental, era of the young industry may be said to go from 1861 to 1871. During this period the most popular grape was the old «Mission.» It was hardy, vigorous, and a good bearer. The «Mission» yielded a dry wine of rather inferior quality, which for some years prejudiced dealers and buyers against the Californian product. It will, however, produce a sweet wine, of the sherry type, of good quality.

After a while it was demonstrated that the fine wine grapes of Europe would succeed and

flourish in different parts of California. And then French, German, and Italian vintners turned their attention to the vines they knew or had grown in the Old Country.

After 1871 grape growing in the State began to go backward, and this continued till 1879, when there came a "turn" in the industry. There was a short crop that year; the prices for grapes and wine went up, and soon there was renewed interest in viticulture. In response to a demand, a State Board of Viticulture was created in 1880. The board was composed of able and practical growers from the leading districts of the State, and their work resulted in a revival of the industry.

According to the census of 1890, there were then in California 155,272 acres of bearing vines; the output of wine that year amounted to 14,626,000 gallons. The wine crop reached its height in 1897, when it was 34,000 gallons. The dry and sweet wine production of California for 1902 is put at 28,000,000 gallons. The assessors' returns for the present year (1903) show a total area of vines in California of 230,675 acres, of which 118,209 acres are in wine grapes, and 89,792 acres in raisin grapes, and the balance table grapes. See RAISIN INDUSTRY, AMERICAN.

The shipping of California table grapes to the eastern markets now amounts to about 1,200 carloads. The California shippers of table grapes labor under the difficulty of long distance from their markets. They have fine, beautiful varieties of grapes, but many of them will not stand the journey to the eastern markets.

The leading varieties of California table grapes are: Flame Tokay, Emperor, Cornichon, Black Malvoisie, Rose of Peru, Muscats, Thompson's Seedless, the Chasselas varieties.

Practical Side of Grape Culture.— The practical part of vine-growing can not be learned from books, but is the result of hard work and years of experience. However, some of the more important features of vine cultivation may be mentioned. Of course, climate, location, and soil play an important part in the yield and in the quality of the fruit. From early times the vine was generally set out on the hills with southern or eastern exposure. It is another curious fact that the leading grape districts of Europe and of the United States are located near a body of water. It is so in the great Medoc district of France, situated between the rivers Garonne and Gironde, and in Germany along the river Rhine. In the eastern States we have the leading districts along the Hudson River, on the banks of Lake Keuka in central New York, and along the shores of Lake Erie in northern Ohio. Such large bodies of water keep the vines from late spring or early fall frosts, and from heavy dews and fogs.

Propagation.— The propagation of the vine may be accomplished by seeds, cuttings, layers, and grafts. The wild grape grows from, and multiplies by, the seed only. It reproduces itself, and its seedlings differ seldom from the parent vine. But, if we take the seed of the cultivated vine, the seedlings show a wide variation, and that is seldom wanted, unless as an experiment to obtain new varieties. The usual method of vine propagation is by cuttings, which are made in the winter from the trimming of the vines. The cuttings are planted early in the spring, after the ground is thoroughly well prepared. It is usual to let the plants grow one or two years. The methods of transplanting these vines are various, due to the nature of the vines and to the methods followed in the various districts. Thus, in California rooted vines of one year are preferred; in the eastern States growers prefer two-year-old transplanted vines.

Grafting.— The grafting of the vine, as with other woody plants, is quite easy, although it may be done in a number of ways. The time to graft is early in the spring before the sap starts. Fully a dozen methods have been named and described. The two kinds in most common use are the ordinary cleft or shoulder-graft, and the English or whip-graft. An ordinary graft is simply done by cutting the vine off three or four inches below the surface of the ground, then split with a grafting chisel, and held open with a wedge until the scion is fitted exactly into place. The cleft may be tied with a string, or covered with clay or grafting wax, and then the earth is heaped about the graft, leaving one bud of the scion above the surface. Grafting is of great importance to every vine grower in Europe and in California. For it is by grafting European vines on American stock that they can be protected from that dread scourge, phylloxera.

Pruning and Training.— The value of removing a portion of the vine, and other woody plants, was recognized at a very early date. Most of our native grapes are more vigorous growers and show a greater tendency to climb and spread than do the European vines. Pruning relates to the removal of such parts of the vine as ensures better fruit and larger yield. The general principles of pruning are practically the same for all vines, and these principles as given by Prof. L. H. Bailey are: (1) Fruit is borne on wood of the present season, which arises from wood of the previous season; (2) a vine should bear only a limited number of clusters, and (3) the bearing wood should be kept near the original trunk or head of the vine. Thus, the wood is constantly renewed, and new shoots which give wood, or canes, for the following year, are called "renewals."

Training relates to the form and disposition of the different parts of the vine. It is not necessary to describe the different methods of training. Each large vineyard district has its own system.

Brief mention may be made of the three well-known ways of training the native vine outside of California: (1) The so-called "Kniffin system" first obtained in the Hudson River district. The vine is allowed to grow at will the first season after planting; the second year it is cut back two or three buds from the ground, and from the stub only one shoot is allowed to grow. This is tied to a stake, at intervals, as it grows, to keep it straight to the height of the trellis. In the third year posts are set about 16 feet apart between every two vines. Two wires are then stretched along the posts, the upper wire about five and a half feet above the ground, and the lower one about half way between the upper wire and the ground. The vine is now tied to each wire, and cut off even with the upper one. The next year all the buds on the vine are rubbed off, except four — two for each wire. The two arms on the top wire are often bent down to the second wire, thus forming a droop, and the system is known as the "drooping system" of training.

(2) The Chautauqua system of vine training, as it may be called, is largely used in the vineyards of that district. In the first year the vine is cut back to three or four buds. The second year it is cut back to five or six buds, and three of the strongest shoots are left to grow the fruit-bearing arms for the third year. The trellis consists of three wires. Each year three or four of the strongest new canes are trained upon the trellis spread out in a fan shape.

(3) The Munson system of vine training is named after T. V. Munson, of Texas, a prominent viticulturist and is adapted to the native vines of the southern States. The trellis used is little different from that of the other systems. Thus, the posts are set about 24 feet apart, and carry two lines of wire. The vine is pruned back in the first year, and the next year the two arms may be allowed to bear a few clusters, if the vine is strong. The «bearing arms» are then cut back to 1 or 2 eyes each; the other arms to 8 or 10 eyes. These arms bear the next year, and are pruned for the third year quite short, while the bearing arms for the next year are pruned long. By this system of training there is a shifting of the bearing canes from one side of the vine to the other; all of which, it is claimed, gives vigor to the vine and a good distribution of the fruit.

Diseases of the Vine.— These are caused by animal and vegetable parasites. Of the former the worst and best known is the phylloxera. An American entomologist, the late Prof. C. V. Riley, discovered that some of our native American vines, were infested by phylloxera, but they successfully resisted its attacks. He therefore recommended to the French and other growers of European grapes, that they graft their vines on American stocks. This proved to be the solution of the problem, and practically all of the millions of vines planted in France during the past 25 years, are on «resistant stocks,» or American species of vines. It is the same in California, where the vineyards destroyed by phylloxera, have been and are being replaced by vines grafted on American stocks. The main thing now is to get the right «resistant vines» for different soils and different climates. The other insect pests are the grape leaf-hopper, the root-worm, the flea-beetle, thrips, rose-bug, etc.

The leaf- or vine-hopper often does considerable damages in the vineyards of the East as well as in California. The best remedy so far recommended is a solution of whale-oil soap applied in a spray. The root-worm is at present working in the vineyards of Chautauqua and in northern Ohio. Two or three sprayings of arsenate of lead during the season is recommended, but thorough cultivation is regarded as the best check to the root-worm. See Insecticides.

The leading vegetable diseases of the vine are mildew, black rot, oidium, anthracnose, anaheim, etc. The effects of mildew are seen on the leaves, stem, and the fruit. This disease is indigenous in this country, and first appeared in 1878 in Europe, where it spread over the vineyard districts, France, Germany, Italy, and Spain, doing great damage.

Black rot was also introduced into Europe from the United States, but there it was not as serious as with us. The rot first affects the leaves and then passes to the fruit. The condition most favorable for the spread of both mildew and black rot is warm, moist weather. See Fungi and Fungicides.

The Evolution of American Grapes.—It should be noted, in conclusion, that the development of American grape culture has been a process of evolution with a survival of the fittest. Thus, the improvement in the quality of our native grapes has been something remarkable. It represents the difference between the wild grape — coarse, harsh, and often disagreeable in taste and smell — and the cultivated grape — tender, luscious, and sweet and delicate in flavor.

The botanists have described and put American grape vines into some 12 or 13 groups or classes. Only 4 American species of vines have been cultivated and developed to any extent, as follows: (1) *Vitis Labrusca;* (2) *V. Estivalis;* (3) *V. Riparia;* (4) *V. Rupestris.*

The *V. Labrusca* is generally known as the «fox grape,» and is a native of the Atlantic slope from New England to South Carolina. The largest number of varieties of grapes in all the Eastern States now cultivated spring from this species, which includes the Concord, the Catawba, etc.

The *V. Estivalis* is the «summer grape» of the Middle and Southern States. Several varieties (such as the Lenoir or Jacquez, Herbemont, Cunningham, etc.) have been much used in France and in California as a grafting stock.

The *V. Riparia* is the grape vine of the river banks, and is found growing wild from Canada to the lower Mississippi Valley. This species is very highly regarded in France and California as a stock on which vinifera vines have been grafted with success.

The *V. Rupestris* is native of the country west of the Mississippi River from Missouri to Texas. The varieties of this species have not been much cultivated, but are used, almost exclusively, as resistant stocks in France and in California.

Thus far, the efforts of our horticulturists to develop and improve many new varieties of American grapes has been confined to a few species. In 1830 William Prince enumerated but 88 varieties of native grapes; to-day there are more than 800 kinds. Already they have accomplished splendid results by cultivation, and by hybridizing our vines with the best foreign kinds. We may look in the near future for the production of many choice grapes which will combine all the vigor, beauty of foliage, and resistance to disease of the Labrusca and other American families with the delicate and fine qualities of the vinifera, or European varieties.

Bibliography.— The most complete books on grape culture have been written by the French experts, but their writings do not apply to American grape culture. Among the best books on the subject in French we may name the following: Guyot's 'Etude des Vignobles de France,' 3 vols., Paris 1876; Foex's 'Cours complet Viticulture,' Paris 1875, and Coste-Floret's 'Les Travaux du Vignoble,' Paris 1898. The leading journal is the 'Revue de Viticulture,' published at Paris.

Books on American or Eastern Grape Culture: Fuller, 'Grape Culturist,' New York 1866; Mead, 'Treatise on American Grape Culture,' New York 1867; Husmann, 'American Grape-Growing and Wine-Making,' New York 1896. The most complete account of our native wines

is found in the 'Descriptive Catalogue of American Grape Vines,' by Bush & Son & Meissner, 4th ed. St. Louis 1895. Consult also: Prof. L. H. Bailey, 'Evolution of Our Native Fruits'; the reports and bulletins of the United States Department of Agriculture.

Books on California Grape Culture: Husmann, 'Grape Culture and Wine-Making in California,' San Francisco 1880; E. J. Wickson, 'California Fruits'; Hyatt, 'Grape Culture and Handbook for California'; Wait, 'Wines and Vines of California,' San Francisco 1889; also the reports of the Board of State Viticultural Commissioners of California, 1881–1893. See VITICULTURE; WINE-MAKING.

LEE J. VANCE,
Editor 'American Wine Press,' New York.

Grape Ferns. See FERNS AND FERN ALLIES, *Ophioglossales.*

Grape, or **Globe, Hyacinth.** See HYACINTH.

Grape Insect-pests. More than 200 species of insects have been observed preying on the grape-vine in America. The principal pest is the phylloxera (*Ph. vastatrix*), which first attracted attention by its ravages in the vineyards of France about 1865. It now occurs in vine-growing countries all over the world, and is the worst of the very few insect-pests that have emigrated from America. It caused the destruction of 2,500,000 acres of vineyards in the United States in 1884. The phylloxera is a minute brownish plant-louse of the aphid family. (See APHIS.) The winged females appear in Europe from August to October. Each lays about four parthenogenetic ova on the under surface of the vine-leaves. These ova develop in late autumn into males and females — wingless and without the characteristic piercing and sucking mouth-organs — which migrate to the stem of the vine. There each female lays a single egg under the bark. This egg lies dormant throughout the winter, and develops in April or May into a wingless but voracious "vine-louse." This form may pass to the leaves, on which it lays parthenogenetic eggs, and forms galls; but in Europe it attacks the roots, and lays its eggs there. From these in about 8 days young develop, which become mature females in about 20 days, and lay more eggs in the roots. Half a dozen or more of these parthenogenetic generations follow in rapid succession throughout the summer. The roots become knotted and deformed; the whole plant suffers, and, though it may survive for several seasons, eventually dies. In midsummer, among the subterranean forms, a generation is born whose members, after four, instead of the usual three, moltings associated with adolescence, become the larger winged females with which we commenced.

The destruction of this scourge of the grape-vine, without also injuring or destroying the plants, has proved exceedingly difficult when attempted upon a large scale, where the expense prevents the use of chemicals or methods effective in a small garden. Water, wherever it can be applied to the soil so as to saturate and keep it saturated for a time, has proved a safe and effectual destroyer, because the insect cannot live in a medium saturated with water for long. Chemical remedies, such as bisulphide of carbon, have succeeded, when injected into the soil about the roots. In some of the French vineyards grafting the cultivated vines on certain of the native vines of America has been tried with some success. Although the insect seems to feed on the roots of these vines, the greater vigor of the American stocks appears to enable them to resist the injuries inflicted on them.

An important vine-pest in certain parts of the United States is the grape root-worm (*Fidia viticida*). Injury is chiefly due to the work of the larvæ or "root-worms," but the beetles also injure the plants by gnawing many holes in their surfaces. The larvæ may be destroyed with bisulphid of carbon injections in the soil about the roots; or better by saturating the soil with kerosene emulsion, 10 times diluted, and systematic spraying. One of the most troublesome enemies of the vine is the rosechafer (*Macrodactylus subspinosus*), which is best kept in subjection by planting trap-crops of plants bearing white flowers which blossom at an earlier date than the grape, such as white rose, blackberry, spiræa, and deutzia. The grape-vine flea-beetle (*Haltica chalybea*) does considerable damage at times to grape leaves, but can readily be destroyed with an arsenical spray, and may also be caught in the same manner as the plum curculio, by jarring the insects on to collecting frames saturated with kerosene. Nearly everywhere leaves will be seen drawn together and slowly assuming a brownish hue, and when these are opened a small caterpillar will be found actively wriggling about. This is the grape leaf-folder (*Desmia funeralis*). When vines are sprayed for leaf-feeding insects some of these leaf-folders will be destroyed, but picking and burning the affected leaves is more effective, taking care that the larvæ do not escape to the earth during the process. Leaf-hoppers do much injury in some localities, particularly on the Pacific coast, and several other important enemies of the grape are known, including cutworms, which climb and defoliate vines at night, the grape-berry moth, which destroys the berry, and the grape curculio, which has the same habit. Consult: Cornu, 'Etudes sur le Phylloxera vastatrix' (1879); Lichtenstein, 'Histoire du Phylloxera' (1878); Riley, 'Sixth Annual Report of the State Entomologist of Missouri' (1874); Saunders, 'Insects Injurious to Fruits' (1883); Marlatt, 'Farmers' Bulletin, No. 70,' issued by the United States Department of Agriculture; Bruner, 'Report of the Nebraska State Horticultural Society' for 1895, which gives an extensive bibliography; Riley, 'Third Report State Entomologist of Missouri' (1871).

Grape-shot is a combination of small cannon balls put into a thick canvas bag, and corded strongly together, or fixed in a cylindrical frame, the diameter of which is equal to that of the ball adapted to the cannon. The number of shot in grape varies according to the service or size of the guns, usually, however, a round of grape-shot consists of nine balls in tiers of three.

Grape-sugar. See GLUCOSE.

Grapefruit, Pomelo, Pomelos, Pumelo, Shaddock, Forbidden Fruit, Fruit of Paradise, a tree (*Citrus Decumana*) of the natural order *Rutaceæ,* native of southeastern Asia, from whence it has been introduced in many warm

countries. It is widely cultivated in the West Indies, California and somewhat in southern Florida. The lemon-colored fruit, which is as large as a large orange, is highly prized for its usually pale yellow or greenish-white subacid lemon-like pulp. Propagation and cultivation are practically the same as for the lemon and orange (qq.v.).

Graphic Method, a pictorial method of representing forces, motions, etc., by lines. Similarly, any other physical quantity, such as temperature, atmospheric pressure, or barometric height, electric potential, etc., may be represented by straight lines. Graphic methods are largely employed in physical investigations as aids to calculation, and for the purpose of exhibiting the nature of the law according to which some phenomena vary. The principal use of this method is to show the mutual variations of two quantities. This we will illustrate by a particular example. Suppose a table is drawn up, in one column of which are the months of the year, and in the other the corresponding average temperatures of the air, at some particular place, during these months (the average temperature for each month being the mean of the daily temperatures). Let two lines, OX and OY, be drawn from O, one horizontally, the other vertically; let the successive months of the year be represented on any convenient scale along OX, and let temperature be measured along OY, also on a convenient scale. Corresponding to each month in the year there will be a length along OX, and to each temperature there will correspond a point on OY. At the middle point corresponding to each month draw perpendicular to OX a line representing the temperature on the scale of OY. A series of lines will thus be obtained, through the upper ends of which there may be drawn, freehand, a smooth curve. The points on the curve in the figure represent the upper ends of these lines. A general glance at such a curve will reveal certain features regarding the temperature of the whole year; at what dates maxima and minima occurred; when the temperature rose or fell quickest, and so on.

Graphite. Graphite is manufactured in large quantities at Niagara Falls from the ordinary forms of amorphous carbon, large quantities of anthracite coal being converted into this product. The present artificial production of graphite amounts to no less than 1,250 tons per annum. The art of converting the various forms of amorphous carbon into graphite was discovered and developed by Mr. E. G. Acheson, to whom the art of producing carborundum is also due.

E. G. ACHESON.

Graph'ophone. An apparatus similar in principle to the Edison phonograph (q.v.), and designed to reproduce human speech and other sounds. It was invented conjointly by Messrs. C. A. Bell and Charles S. Tainter, and differs from the phonograph merely in its mechanical details of construction, and in the employment of a wax-coated cylinder of pasteboard instead of a solid wax cylinder.

Graph'otype, a process of engraving discovered in 1860 by De Witt Clinton Hitchcock, by which the valuable improvement is effected of enabling the artist to be his own engraver. The discovery is utilized in the following manner: French chalk is by a careful process ground to the finest powder, which is repeatedly passed through a wire-cloth with 10,000 holes to the square inch. It is then laid between a smooth plate of zinc and a smooth plate of steel, and submitted to intense hydraulic pressure, after which it is sized to prepare it for the artist. The pencils used by the artist are of sable-hair, and the ink is composed of lamp-black and glue. The drawing, when finished, is gently rubbed with silk velvet or fitch-hair brushes until the chalk between the ink lines is entirely removed to the depth of one eighth inch. The block is then hardened by steeping it in an alkaline silicate, by which the whole of the chalk is converted into stone. Molds are then taken of it, from which stereotype plates are cast for printing. See ZINCOTYPE.

Graptolites, grăp'tō-līts, a name given to fossils, characteristic of the Upper Cambrian, Ordovician, and Silurian strata, now regarded as belonging to the Cœlenterata, and to that class under which the sea-firs (*Sertularia*, etc.) are arranged. They consist of a rod or axis, which appears solid, but may have been hollow during life, and of cells disposed on both sides of this rod. These cells open one above another in the same vertical plane, while, by the other end, they open into a cavity which is common to all the cells on one side of the axis, this common cavity being characteristic of the Hydrozoa. These fossils seem to have been of horny consistence during life, for they are, with few exceptions, found flattened on the surface of shales and never calcareous. They live rooted in the mud; not attached to any object, but simply anchored by their base, like the living sea-pens.

Gras, Felix, fā-lěks, Provençal writer: b. Malemont, near Avignon, 3 May 1844; d. Avignon 4 March 1901. His education ceased at 17, when he returned to his father's farm, from which he was sent, in 1864, to Avignon and articled to Jules Giéia, a man of letters as well as a lawyer, and a member of Félibrige, a Provençal literary club of which Frederic Mistral (q.v.) was a member. Amid such surroundings he accepted law as his profession but resolved on literature as his vocation. In 1876 he published his first important work, an epic poem in 12 cantos, 'Li Carbounie,' which won for him the first place among Provençal writers of the younger generation. 'Toloza,' an epic recounting the crusade of Simon de Montfort against the Albigenses, followed in 1882. He proved himself second only to Mistral among Meridionals by a collection of his shorter poems to which he gave the title 'Lou Roumancers Prouvençal' (1887). In his collections of prose stories, 'La Papalmo' (1891), he fancifully describes, in vivid, racy style, the loves and hates, sensuality and «superstition» of the papal court at Avignon. His greatest popular success, 'Li Rouge dóu Miejour' (1896), was published in a translation, 'The Reds of the Midi,' before it saw the light in France, where it is not so popular as among those who read it in the English version alone. A more recent work, which has been translated in the United States under

the title 'The White Terror,' describes the retaliatory violence of the Royalists in the south, when the storm of the Revolution had swept by. For 10 years previous to his death he had been Capoulié, or president of the Félibrige.

Grasmere, grăs'mēr, England, village, in Westmoreland County; on the lake of the same name. It has been made famous by the "Lake School of Poets," Wordsworth, Southey, and Coleridge. Many places in Grasmere and the surrounding lake country have been mentioned in the poems of the authors who frequented this section, especially by Wordsworth. The graves of Wordsworth and Hartley Coleridge are in Grasmere.

Grass. See GRASSES IN THE UNITED STATES.

Grass, Straw, or Pampas Cat, a wildcat (*Felis pajeros*) of southern South America, common on the grassy plains. It is described by Hudson ('A Naturalist in La Plata,' 1892) as not unlike the European wildcat in its robust form and dark color, "but a longer, more powerful animal, inexpressibly savage in disposition."

Grass-bass, the calico-bass (q.v.).

Grass, China. See RAMIE.

Grass-finch. See VESPER SPARROW.

Grass-pink, or **Calopogon,** a showy orchid (*Limodorum tuberosum*), with a small bulbous root, large ovate leaves, sheathed at the base, and flowers growing in a loose spike upon a slender stem 12 to 18 inches high; they are butterfly-shaped, fragrant and magenta pink; and the lip, which is exquisitely bearded with gay colors, remains on the upper side of the flower, giving the blossom an upside-down appearance. It is common in boggy places from Florida to Newfoundland. Several other species of the genus occur in the South, one of which (*L. multiflorum*) bears many more flowers than does the grass-pink.

Grass-snake. In the United States a greenish unstriped variety of the garter-snake (q.v.). In Great Britain the European water-snake (*Tropidonotus natrix*), which closely resembles our American water-snake (q.v.), but is rather more terrestrial and even arboreal in its habits. It is the only serpent in England except the viper, and does not occur in Ireland or Scotland, but is common all over southern and central Europe, in Algeria, Asia Minor, and eastward to India.

Grass-snipe, a gunner's name for the jack-snipe (q.v.), and some other shore-birds of similar habits.

Grass-tree, the popular name for certain tree-like Australian sedges (*Juncaceæ*). Their large stems are crowned by thick tufts of narrow, pendulous foliage which in turn display cylindrical flower-spikes like exaggerated cat-tails. The plant contains an aromatic resin (Botany-bay gum or gum acaroides) employed in pharmacy, and also used by the natives for a variety of purposes, such as calking canoes, and as a cement or glue. These plants are also called 'black-boys' from the appearance of the stems when charred by fire, and from the fact that the black-skinned natives often use them as a means of concealment, or even imitate the appearance of a charred stem by crouching into a similar attitude, and so escape the eyes of enemies.

Grass Valley, Cal., city, in Nevada County; on the Nevada County Narrow Gauge R.R.; about 3 miles northeast of Marysville. It was one of the first settlements made after gold had been discovered in the State. It is in a rich gold quartz mining region, and the chief occupations are connected with mining. It has granite and marble works, a distillery, and large wineries. Pop. 4,825.

Grass Worm, the caterpillar of a noctuid moth (*Laphygma frugiperda*), which often does great damage to grasses and cereals in the Southern States, and to a great variety of crop plants, as in 1899, when a serious outbreak of this species extended from Mexico to Chicago. In the North it is known as the fall army-worm, from the fact that it appears and travels in greatest numbers in the autumn, devouring nearly every form of vegetation encountered in its line of march.

Grass-wrack, a maritime grass. See EEL-GRASS.

Grasse, François Joseph Paul, frän swä zhō-zĕf pōl grăs, COUNT DE, French admiral: b. Valettes, Provence, 1723; d. Paris 11 Jan. 1788. He first entered the navy of the Knights of Malta, and served against the Turks; in 1749 entered the French navy, became captain in 1762, and rear admiral in 1778, and was appointed to command a squadron sent to the West Indies. In 1781 he was given the rank of admiral and sent with a fleet to coöperate with the land forces in the American colonies. He first assisted at the taking of Tobago, in the West Indies, then sailed to the mouth of the Chesapeake, where he repulsed the attack of the British fleet under the command of Graves, prevented aid from reaching Cornwallis at Yorktown, and cut off his retreat, thus materially assisting the decisive American victory there; for these services he received the thanks of Congress. He then went to the West Indies, where for a time he was successful against the British, capturing the island of St. Christopher; but on 12 April 1782 was surprised by the English fleet under Rodney, and after a hard fight defeated, and taken prisoner. He was accused of carelessness and even treachery, but was exonerated by an official investigation, and at the time of his death held the rank of lieutenant-general of the naval forces of France.

Grasserie, a disease of silkworms (q.v.).

Grasses in the United States. The term "grass" is popularly applied to the green herbage on which cattle and other beasts feed, and thus includes many plants which are not botanically related to the true grasses, such as the clovers, alfalfa, sanfoin, vetches, spurry, etc., frequently referred to as "artificial grasses," while it excludes some of the most important of the true grasses, namely, the cereals. The true grasses constitute the botanical family *Gramineæ*. They are distinguished from related groups of plants in that the leaves are arranged in two opposite rows on the stem, with a single leaf at each joint. The stems (culms) are usually hollow except at the joints, and the base of the leaf forms a sheath which surrounds the stem above the joints. The sheath is usually extended a short distance above the base of the blade of the leaf,

in a delicate, whitish structure closely surrounding the stem, called the ligule, the office of which seems to be to prevent rain-water from percolating between the sheath and the stem. The grass flower usually consists of the following parts: flowering glume, palet, lodicule, one to six stamens (usually three), and a one-celled ovary usually with two styles tipped with plumose stigmas. The flowers are usually arranged in two rows on opposite sides of the rachilla, constituting a spikelet. At the base of the spikelet are usually two empty glumes. The empty glumes, flowering glumes, and palet constitute the "chaff." The spikelet may contain one to many flowers. The lodicule, which stands in front of the flowering glume, is very small, usually not noticeable except on close examination. At flowering time, the lodicule becomes greatly swollen, and by this means spreads the flower open. In spikelets that contain several flowers, the palet, or inner chaff, rests with its back against the rachilla, and is concave on the back, with a nerve or keel on either side. The edges of the palet are overlapped by the edges of the flowering glume, or outer chaff. The spikelets are arranged either in spikes, as in wheat, or in panicles, as in oats. Popularly, these are referred to as the "seed-head," and this term will be frequently used in this sense in this article. The fruit of the grasses is a seed-like grain, either adherent to the chaff, as in barley, or free from it, as in wheat.

This is one of the largest and most widely disseminated families of plants, and by far the most important to mankind. It includes the cereals, wheat, oats, barley, rye, rice, millets, and corn, sugarcane, sorghum, the cane of the southern canebrakes and the bamboo of the Old World, in addition to the common grasses of the fields and prairies. It furnishes the principal food of both man and beast, and some of the most beautiful ornamental plants (reed, Ravenna grass, plume-grass, ribbon-grass, etc.). The grasses are the foundation of agriculture. Their principal development is in the temperate zones, though grasses are found wherever vegetation flourishes. Singularly enough, the most important grasses, the cereal grains, are not known in the wild state, and their cultivation extends so far back into antiquity that even their places of origin are unknown. Either their wild counterparts have become extinct, or the cereals have been so changed by cultivation that their wild forms are no longer recognizable. There are in all about 4,000 distinct species of grasses known. The species of only two natural orders of flowering plants exceed this number, namely, the *Compositæ* and the *Leguminosæ,* though in the number of individual plants the grasses far surpass all others. The total number of grass species growing in the United States is about 1,400; in the limits of the State of Washington about 275 species are found. Originally, nearly half the area of this country consisted of prairies, the principal herbage of which was grasses. The existence of these vast stretches of grass-land has never been fully accounted for. It is not due simply to climatic and soil conditions, for many species of trees readily grow on the prairies when placed there by man. In recent years, vast areas that were formerly occupied by grasses have been invaded by various shrubs and trees, particularly the mesquite tree of the Southwest. This has occurred simultaneously with the destruction of the grasses by stock, indicating that the presence of the grasses is inimical to forest growth. It is well known that grasses thrive best on the more compact soils. On such soils, the abundant growth of grass, with the fires that have swept over these regions in dry seasons from time immemorial, has kept in check those classes of vegetation which could not quickly recuperate after the destruction by fire of their aërial portions. On the coarser types of soil, the sparse growth of grass, and the consequent lack of fuel to feed the fires, has enabled forest trees to become established. These facts, while they do not entirely account for the existence of prairies, are undoubtedly an important element. The prairies are particularly developed in the arid and semi-arid regions where frequent drouth has augmented the destruction occasioned by fires, and particularly on the heavier soils of that region which retain sufficient moisture to enable the grasses to form a complete covering over the soil.

Of the many grasses (popularly known as such) native to this country, or of the introduced grasses that have become established here, comparatively few are of economic importance. Their principal use is as food for live stock. Most of them grow too sparsely to be important for this purpose, and many of them are not nutritious enough to make them valuable as food. A considerable number, however, are both nutritious and palatable to stock. Yet the number of these which are propagated artificially is exceedingly small when compared with the total number of species. This is partly accounted for by the fact that a few species are surpassingly useful by reason of abundant growth, ease of propagation, nutritive value, and palatability. When such a grass becomes established in a region to which it is adapted, the effort to find other valuable sorts in a measure ceases. But there are vast sections of country, particularly in the cotton-producing States and the arid and semi-arid West, where good grasses, adapted to local soil and climatic conditions, have not yet become established as field crops. Not that there are no good grasses known in these regions, for there are many of them; but it happens that these grasses are not easily propagated or have some characteristic which renders them undesirable. The well-known and valuable buffalo grass (*Bulbilis dactyloides*) of the West and Southwest is an example in point. It is one of the most nutritious and palatable of all the grasses, and produces abundant feed; but it produces very little seed, and that only on trailing vine-like stems, from which it is impractical to harvest it. Many of the grasses which formerly constituted important factors on the ranges of the West, and which are eminently adapted to the climatic and soil conditions there, are rendered useless on cultivated lands by reason of their poor seed habits. What the breeder's art may accomplish in rendering these now useless grasses useful, by improving their seed habits, remains to be seen. The leading tame grasses of the country are as follows:

Timothy (*Phleum pratense*).— The acreage of this grass in the United States is twice as great as that of all other cultivated grasses put together. It may be said to be the hay grass of the country. Its supremacy is due first of all to its excellent seed habits. The seed from an acre of it will seed a larger acreage than is the case

with any other grass. The seed is easily harvested, and retains its vitality for several years. It also produces relatively large yields of hay, which, although not so nutritious as the hay from some other grasses, is eaten readily by all kinds of stock. It is particularly valuable for horses, because of its favorable physiological effect on the digestive apparatus. Owners of livery stables, whose horses are liable to be subjected to hard driving after heavy feeding, will feed no other hay when timothy is available. Timothy is usually sown with wheat, in fall, at the rate of about eight pounds of seed per acre, the seed being cast on the bare ground behind the drill-plows. Clover is then frequently added, at the same rate, in early spring, though farmers who raise much hay for sale prefer to omit the clover, as the pure timothy is preferred by horsemen. After the wheat crop is harvested, the grass is ordinarily used for pasture in the fall. The next season a large yield of hay is obtained (one to three or more tons per acre, according to the fertility of the soil), but the yield decreases thereafter to such an extent that the best farmers do not attempt to maintain a timothy meadow for more than two seasons, though such fields are frequently used for pasture for two or three years longer, before breaking them up for corn. In the latter case, bluegrass seed (*Poa pratensis*) is frequently scattered on the timothy sod, so that the pasture consists largely of bluegrass. The production of timothy hay is confined largely to the region north of and including the eastern third of Kansas and Nebraska, and to certain restricted localities in the Rocky Mountains and Pacific coast States; but timothy hay is used almost exclusively by horsemen in the large cities of all sections of the country.

Kentucky Bluegrass, June Grass, or Bluegrass (*Poa pratensis*).— Next to timothy this is the most important grass in this country, though it seldom grows large enough to cut for hay. It is undoubtedly the leading pasture grass in America. Its distribution is nearly identical with that of timothy. It does not extend south of the Ohio River except in a circular area about 100 miles in diameter in Kentucky, with a point 25 miles north of Lexington as a centre; and in certain portions of Tennessee and the mountainous portions of the southern States. In Kentucky and Tennessee its distribution is closely confined to the Cambrian rocks, which are rich in both lime and magnesia. Perhaps no other grass is so acceptable to stock as bluegrass. It is one of the most nutritious of grasses, and it is a notable fact that stock raising has never become a prominent feature of farming anywhere in the United States outside of the bluegrass region, except of course in the range country of the West, where ranching rather than farming is the prevailing form of agriculture. The best bluegrass pastures are those which are kept free from weeds and bushes, not cropped too closely and constantly, and upon which fattening stock are fed grain and mill products. Such pastures last indefinitely, but are hardly productive enough to justify their maintenance except on rough lands not well adapted to the cultivation of ordinary crops. So highly prized are the bluegrass pastures in many sections that they are seldom broken up; for it is a difficult matter to establish a good bluegrass pasture, a process requiring several years.

Millet.— The term millet is applied to three more or less distinct groups of grasses. The more common millets in this country are the foxtail millets (*Chætochloa italica*). They include the well-known foxtail, a common weed springing up in grain fields after harvest, and the hay-producing varieties, Hungarian grass, German millet, golden millet, and a few others, all annuals which produce an abundant crop of coarse hay of rather inferior quality. They are grown mostly as catch crops, being sown in late spring and early summer on fields where other crops have failed because of drouth. They are hence confined largely to the semi-humid region extending from North Dakota to Texas. Millet hay, when fed to horses that have no other roughness, has the peculiar property of producing acute rheumatic affections of the joints; but when fed with other hay, the damage from this source is very slight. Another group of millets, frequently called broomcorn millets, are varieties of the species *Panicum miliaceum*. These are little known in this country, though they constitute important bread-producing crops in central Asia. A third kind of millet, usually known as Japanese millet, is a variety of the common barnyard grass, *Panicum crus-galli*. Some forms of this grass are common weeds all over this country. Some of the varieties produce large crops of coarse but palatable hay, particularly on wet lands in the southern States. The seed of one variety is used for food by certain Indian tribes of the Southwest. Other varieties are similarly used in the Old World. This group of millets probably deserves more attention that it has yet received in this country.

Redtop (*Agrostis alba*).— This grass and its variety *vulgaris* are widely distributed in this country, occupying the whole of the timothy and bluegrass region, and extending considerably farther south; but the only section in which it may be said to hold first place is in a limited area in southeastern Illinois and adjacent parts of Kentucky. In this section, practically all of the redtop seed of the country is produced. It is rather distinctly a wet-land grass, and is usually a valuable constituent of meadows and pastures on moist lands in all parts of the country except the extreme south. In yield of hay it is distinctly inferior to timothy, but it withstands cropping and trampling by stock much better. Although quite nutritious, it is not nearly so well relished by stock as timothy or bluegrass.

Orchard Grass (*Dactylis glomerata*).— In its distribution in this country, this grass is identical with redtop, but it is adapted to drier soils. Particularly in the southern portion of its area, orchard grass flourishes in the shade of trees, hence its popular name. It may be said to be important as a hay grass only in that part of its range which extends beyond the limits of the timothy region. It is particularly important in the clay soils around the base of the Appalachian range from Virginia southward, though it thrives equally well throughout the timothy region. This grass produces a large yield of rather coarse hay, which, however, is of excellent quality if cut by the time the blossoming period is over. If allowed to stand longer, the quality of the hay deteriorates rapidly because of the formation of woody tissue in the stems. A rather serious objection to it is that it is inclined to grow in bunches, making a rough and

uneven surface difficult to mow; yet it is undoubtedly the best of the hay grasses in those portions of its region where timothy does not succeed. It is also an excellent pasture grass, withstanding much hard usage, and furnishing large quantities of herbage. In New Zealand, where this grass is very popular, and in England, it is known as cock's-foot, from the fancied resemblance of its branching seed-head to a chicken's foot.

Bermuda (*Cynodon dactylon*).— With some reservations, it may be stated that what bluegrass is to the North, Bermuda is to the South. The differences are: Bermuda revels in the heat of summer, while bluegrass makes little growth in hot, dry weather. It stands drouth much better than bluegrass. On good land, Bermuda furnishes good crops of hay, which bluegrass does not. Bermuda stands trampling even better than bluegrass, and yields more pasture. On the other hand, Bermuda furnishes pasture only during the warm season; and while it furnishes larger amounts of feed than bluegrass, stock do not relish it quite so well. The seed of Bermuda is also quite unreliable and very high-priced, so that, to insure getting a stand of it, it is the usual custom to plant small pieces of sod, which soon spread over the ground and form a complete covering. One of the most characteristic features of Bermuda is its habit of sending out long runners which run along the surface of the ground, taking root at the joints. This renders it a matter of considerable difficulty to eradicate the grass when it is once established. But this may be done by growing densely shading crops, such as oats in winter, followed by cowpeas or velvet beans in summer, for one or two seasons. A single season of clean culture, such as cotton receives, will then completely destroy the Bermuda. *St. Lucie Grass* is a variety of Bermuda which is found in Florida and near the Gulf coast. It grows considerably larger than the species, and is said to remain green longer in the fall.

Johnson Grass or Means Grass (*Sorghum halapensis*).— This grass was introduced into South Carolina from Turkey near the middle of the last century. In that State it is generally known as Means grass, from Gov. Means, who did much to popularize it. It was later taken to Mississippi by a Mr. Johnson, where it became widely known under his name. The most prominent characteristic of Johnson grass is its habit of producing an enormous growth of underground stems (rootstocks, or rhizomes), from each joint of which a new plant may be produced. It is therefore a matter of extreme difficulty to get rid of the grass when it is once established. It is now very generally distributed over the cotton-producing States, and is the most formidable weed found in the South. It is generally believed that it cannot be exterminated by any practicable means. This, however, is not the case. If the land is thoroughly plowed in autumn, with a disk plow or a good turning plow, the rootstocks dragged from the ground with a good harrow, or better, a root-digger; plowed again in midwinter; then plowed and thoroughly harrowed again in late spring, again removing all the roots possible, a crop of cotton may be grown the following summer nearly free from grass. If then the grass be persistently pulled or cut during the summer, never allowing it to reach a height of four inches, it can be completely eradicated. It is practicable to do this, for very little grass will appear in the cotton, and what does appear will be attached to loose roots easily pulled from the ground. While Johnson grass produces rootstocks in abundance, it spreads very slowly by this means, but spreads rapidly by seed. These are produced in great quantity, are readily eaten by stock, and are thus carried over all parts of a farm on which it has once gained a foothold. Johnson grass usually gives three cuttings of hay in a season, of about a ton each on good land. The hay is of excellent quality, particularly for cattle and for all horses except livery horses liable to be subjected to hard driving after a full feed. In such cases its laxative and diuretic effect becomes objectionable. As a pasture grass it can not be compared with Bermuda, though it is greatly relished by all kinds of stock. It is soon killed down completely when heavily pastured, but when the land is plowed it springs up again.

Brome Grass (*Bromus inermis*).— This is a recent introduction from east central Europe, and on the prairie soils of the Northwest and the Pacific Northwest, it occupies the place that bluegrass holds on the glacial drift of the more humid climate to the East. It is much larger than bluegrass, and hence furnishes more feed. It is much relished by all classes of stock. Stock eat with great avidity the straw from which seed is harvested, and the hay, cut just after the blossoms fall, is of excellent quality. Brome grass forms an excellent sod.

Italian Rye Grass (*Lolium italicum*).— This is perhaps the most important of all the meadow grasses in England and on the continent of Europe. It is relished by stock better perhaps than any other of the cultivated grasses; yet, for some reason not entirely clear, it is almost unknown in America. The only section of the country in which it has gained favor is in northwestern California, western Oregon, and western Washington. It is adapted to a very wide range of soils. It thrives remarkably on land reclaimed from salt marshes by dyking, and it is also a valuable grass on upland soils that are inclined to be dry. Practically speaking, it is an annual, but if properly managed it reseeds itself in such a manner as to be practically a perennial. It is a valuable constituent of all pasture mixtures, and is a hay grass of much value. It is not well adapted to single culture, being rather too weak of stem to stand alone.

English Rye Grass (*Lolium perenne*).— This differs from the last in no essential respect except that it does not grow quite so tall, and is slightly more inclined to a perennial habit. It is an important European grass practically unknown in America.

Tall Fescue and Meadow Fescue (*Festuca elatior*, and variety *pratensis*).— These two grasses differ in no essential particular (from the agriculturist's standpoint) except that the first is taller and more leafy than the second, and therefore more valuable as a forage plant. The smaller form is frequently known as English bluegrass, a name which has led to much confusion, and which should be abandoned. It is not closely related to our Kentucky bluegrass, nor to Canadian bluegrass (*Poa compressa*). Tall fescue is much confused with meadow fescue by seedsmen, and it not infrequently occurs that seed of the latter is sold under the name of tall fescue. This fact has hindered the

recognition of the decided merits of tall fescue. Next to Italian and English rye grass, these two grasses are the most important cultivated grasses in Europe. But like the rye grasses, they have never been recognized as valuable grasses in this country except in a few restricted localities.

Tall Oat Grass (*Arrhenatherum avenaceum*). — This grass is found occasionally in all parts of the country, but is nowhere an important crop. Stock do not eat it readily at first, but soon become accustomed to it, and then eat it freely. It has considerable value both for hay and for pasture.

Cheat, or Chess (*Bromus secalinus*).— In the central and eastern States, cheat is a pernicious weed in wheat fields, and it is popularly believed that, under certain unknown conditions, wheat turns into cheat, and it avails nothing that the fallacy of this notion has been demonstrated time and time again. In some parts of the South, and in the Willamette Valley in Oregon, cheat is sometimes grown for hay. It produces a large yield of rather poor hay. Being an annual, it is of little value for pasture.

Velvet Grass (*Holcus lanatus*).— This grass is common in the Pacific coast region along roadsides and in waste places. On sandy soils along the coast and on peaty soils that dry out in summer. velvet grass is perhaps the most profitable hay and pasture grass, because the better grasses do not succeed. Stock usually refuse to eat it until driven by hunger, but they will soon acquire a taste for it, and it is exceedingly nutritious. Its worst faults are its low yield and lack of palatability.

Canadian Bluegrass (*Poa compressa*).— A grass of small economic value, found quite generally over the northern States and in Canada. It is of some value as a sand binder, and, when kept closely mowed, it forms a smooth, even sod in lawns.

Crab Grass (*Panicum sanguinale*).— This is not, strictly speaking, a cultivated grass. It springs up in cornfields in late summer, and frequently furnishes a considerable crop of hay, which is of fair quality. It is universal in the South and extends northward to the Missouri and Ohio rivers.

Fodder Grasses.— Under this term we may include the coarse-growing grasses such as the sorghums, Kafir corn, Milo maize, teosinte, etc. On account of their large size, they require to be handled in a different manner from the common hay grasses. They are usually cut and shocked after the manner of fodder corn, though most of them may be handled by haying machinery if they are sown quite thick.

The sorghums (saccharine sorghums) were introduced into this country about the middle of the last century, and were extensively grown for syrup making before the now universal adulteration of this class of food materials destroyed the market for all farm-made syrups. At present little sorghum syrup is produced, but the sorghum plant is much grown for fodder. Its most valuable characteristic is its ability to withstand protracted drouth. It is therefore especially adapted to the western edge of the humid region, where it is exceedingly popular. Sorghum is also very generally grown in all the southern States, where the fodder is particularly valuable as a feed for the plantation mules. In all the cotton-growing States, as well as along the edge of the great plains, sorghum is a much more certain crop than corn (maize). Kansas is the leading State in the production of this crop. Some varieties are grown as far north as Minnesota and North Dakota. In the South two or three cuttings may be made in a season.

Several varieties of Kafir corn (non-saccharine sorghums) have become established in this country in recent years. The plant resembles a low-growing, branching, very leafy sorghum. It is cultivated either for fodder or for grain, of which latter it yields abundant crops. The grain is inferior to corn, but its more certain yield in dry seasons renders it a valuable crop in the same sections where sorghum is grown. It is rather more distinctly a southern crop than sorghum, being grown most largely in Kansas, Oklahoma, Texas, and New Mexico. Milo maize is not very widely known in this country, but it is gaining a foothold in parts of Texas, where it is grown after the manner of sorghum and is said to furnish large crops of valuable fodder or hay. Teosinte (*Euchlenea mexicana*) is a tropical plant somewhat resembling sorghum, but in reality more closely related to corn (maize). It does not produce seed in this country, but on rich alluvial soils in the southern States it produces enormous yields of green fodder much relished by cattle. It is of no account on poor thin soils. Near the cities, where dairying is an important industry, this crop is of great value in the South. It may be cut several times in a season, and there is no waste in feeding it, as the stalks are readily eaten.

Pearl millet may be classed with the sorghums on account of its manner of growth, but botanically it is quite different from them. It is a native of Africa, and was introduced in this country about 30 years ago. It has been tried very generally over the country, but has never gained favor. The seed is frequently unreliable, and the stems are inclined to be woody when approaching maturity.

A large number of our wild grasses have more or less economic importance. In fact, a majority of them furnish food for domesticated animals, while some are important for other reasons, as will appear in the discussion below. Only a few, however, are of sufficient importance to warrant their mention here. It is somewhat remarkable that none of our wild grasses have been domesticated during the past hundred years. This is perhaps due to the fact that the best of them were brought into cultivation very early in the history of the country. The more important genera of our wild grasses are:

Andropogon.— This genus is particularly well developed along the eastern edge of the western plains, where several species form important constituents of the immense acreage of wild hay cut in that region; also in the southern States, where it constitutes the major part of the growth of grasses in open woods and abandoned fields. *A. virginicus* is one of the most abundant grasses from Maryland southward. These grasses are large and coarse, and are not much relished by stock except in the early stage of their growth, whence the common practice of burning over the prairies to start a new growth of tender grass.

Agropyron.— This genus is particularly characteristic of the northern Rocky Mountain States, where several species are valuable for forage. They are, as a rule, better relished by stock than

uneven surface difficult to mow; yet it is undoubtedly the best of the hay grasses in those portions of its region where timothy does not succeed. It is also an excellent pasture grass, withstanding much hard usage, and furnishing large quantities of herbage. In New Zealand, where this grass is very popular, and in England, it is known as cock's-foot, from the fancied resemblance of its branching seed-head to a chicken's foot.

Bermuda (*Cynodon dactylon*).— With some reservations, it may be stated that what bluegrass is to the North, Bermuda is to the South. The differences are: Bermuda revels in the heat of summer, while bluegrass makes little growth in hot, dry weather. It stands drouth much better than bluegrass. On good land, Bermuda furnishes good crops of hay, which bluegrass does not. Bermuda stands trampling even better than bluegrass, and yields more pasture. On the other hand, Bermuda furnishes pasture only during the warm season; and while it furnishes larger amounts of feed than bluegrass, stock do not relish it quite so well. The seed of Bermuda is also quite unreliable and very high-priced, so that, to insure getting a stand of it, it is the usual custom to plant small pieces of sod, which soon spread over the ground and form a complete covering. One of the most characteristic features of Bermuda is its habit of sending out long runners which run along the surface of the ground, taking root at the joints. This renders it a matter of considerable difficulty to eradicate the grass when it is once established. But this may be done by growing densely shading crops, such as oats in winter, followed by cowpeas or velvet beans in summer, for one or two seasons. A single season of clean culture, such as cotton receives, will then completely destroy the Bermuda. *St. Lucie Grass* is a variety of Bermuda which is found in Florida and near the Gulf coast. It grows considerably larger than the species, and is said to remain green longer in the fall.

Johnson Grass or Means Grass (*Sorghum halapensis*).— This grass was introduced into South Carolina from Turkey near the middle of the last century. In that State it is generally known as Means grass, from Gov. Means, who did much to popularize it. It was later taken to Mississippi by a Mr. Johnson, where it became widely known under his name. The most prominent characteristic of Johnson grass is its habit of producing an enormous growth of underground stems (rootstocks, or rhizomes), from each joint of which a new plant may be produced. It is therefore a matter of extreme difficulty to get rid of the grass when it is once established. It is now very generally distributed over the cotton-producing States, and is the most formidable weed found in the South. It is generally believed that it cannot be exterminated by any practicable means. This, however, is not the case. If the land is thoroughly plowed in autumn, with a disk plow or a good turning plow, the rootstocks dragged from the ground with a good harrow, or better, a root-digger; plowed again in midwinter; then plowed and thoroughly harrowed again in late spring, again removing all the roots possible, a crop of cotton may be grown the following summer nearly free from grass. If then the grass be persistently pulled or cut during the summer, never allowing it to reach a height of four inches, it can be completely eradicated. It is practicable to do this, for very little grass will appear in the cotton, and what does appear will be attached to loose roots easily pulled from the ground. While Johnson grass produces rootstocks in abundance, it spreads very slowly by this means, but spreads rapidly by seed. These are produced in great quantity, are readily eaten by stock, and are thus carried over all parts of a farm on which it has once gained a foothold. Johnson grass usually gives three cuttings of hay in a season, of about a ton each on good land. The hay is of excellent quality, particularly for cattle and for all horses except livery horses liable to be subjected to hard driving after a full feed. In such cases its laxative and diuretic effect becomes objectionable. As a pasture grass it can not be compared with Bermuda, though it is greatly relished by all kinds of stock. It is soon killed down completely when heavily pastured, but when the land is plowed it springs up again.

Brome Grass (*Bromus inermis*).— This is a recent introduction from east central Europe, and on the prairie soils of the Northwest and the Pacific Northwest, it occupies the place that bluegrass holds on the glacial drift of the more humid climate to the East. It is much larger than bluegrass, and hence furnishes more feed. It is much relished by all classes of stock. Stock eat with great avidity the straw from which seed is harvested, and the hay, cut just after the blossoms fall, is of excellent quality. Brome grass forms an excellent sod.

Italian Rye Grass (*Lolium italicum*).— This is perhaps the most important of all the meadow grasses in England and on the continent of Europe. It is relished by stock better perhaps than any other of the cultivated grasses; yet, for some reason not entirely clear, it is almost unknown in America. The only section of the country in which it has gained favor is in northwestern California, western Oregon, and western Washington. It is adapted to a very wide range of soils. It thrives remarkably on land reclaimed from salt marshes by dyking, and it is also a valuable grass on upland soils that are inclined to be dry. Practically speaking, it is an annual, but if properly managed it reseeds itself in such a manner as to be practically a perennial. It is a valuable constituent of all pasture mixtures, and is a hay grass of much value. It is not well adapted to single culture, being rather too weak of stem to stand alone.

English Rye Grass (*Lolium perenne*).— This differs from the last in no essential respect except that it does not grow quite so tall, and is slightly more inclined to a perennial habit. It is an important European grass practically unknown in America.

Tall Fescue and Meadow Fescue (*Festuca elatior,* and variety *pratensis*).— These two grasses differ in no essential particular (from the agriculturist's standpoint) except that the first is taller and more leafy than the second, and therefore more valuable as a forage plant. The smaller form is frequently known as English bluegrass, a name which has led to much confusion, and which should be abandoned. It is not closely related to our Kentucky bluegrass, nor to Canadian bluegrass (*Poa compressa*). Tall fescue is much confused with meadow fescue by seedsmen, and it not infrequently occurs that seed of the latter is sold under the name of tall fescue. This fact has hindered the

recognition of the decided merits of tall fescue. Next to Italian and English rye grass, these two grasses are the most important cultivated grasses in Europe. But like the rye grasses, they have never been recognized as valuable grasses in this country except in a few restricted localities.

Tall Oat Grass (*Arrhenatherum avenaceum*).— This grass is found occasionally in all parts of the country, but is nowhere an important crop. Stock do not eat it readily at first, but soon become accustomed to it, and then eat it freely. It has considerable value both for hay and for pasture.

Cheat, or Chess (*Bromus secalinus*).— In the central and eastern States, cheat is a pernicious weed in wheat fields, and it is popularly believed that, under certain unknown conditions, wheat turns into cheat, and it avails nothing that the fallacy of this notion has been demonstrated time and time again. In some parts of the South, and in the Willamette Valley in Oregon, cheat is sometimes grown for hay. It produces a large yield of rather poor hay. Being an annual, it is of little value for pasture.

Velvet Grass (*Holcus lanatus*).— This grass is common in the Pacific coast region along roadsides and in waste places. On sandy soils along the coast and on peaty soils that dry out in summer, velvet grass is perhaps the most profitable hay and pasture grass, because the better grasses do not succeed. Stock usually refuse to eat it until driven by hunger, but they will soon acquire a taste for it, and it is exceedingly nutritious. Its worst faults are its low yield and lack of palatability.

Canadian Bluegrass (*Poa compressa*).— A grass of small economic value, found quite generally over the northern States and in Canada. It is of some value as a sand binder, and, when kept closely mowed, it forms a smooth, even sod in lawns.

Crab Grass (*Panicum sanguinale*).— This is not, strictly speaking, a cultivated grass. It springs up in cornfields in late summer, and frequently furnishes a considerable crop of hay, which is of fair quality. It is universal in the South and extends northward to the Missouri and Ohio rivers.

Fodder Grasses.— Under this term we may include the coarse-growing grasses such as the sorghums, Kafir corn, Milo maize, teosinte, etc. On account of their large size, they require to be handled in a different manner from the common hay grasses. They are usually cut and shocked after the manner of fodder corn, though most of them may be handled by haying machinery if they are sown quite thick.

The sorghums (saccharine sorghums) were introduced into this country about the middle of the last century, and were extensively grown for syrup making before the now universal adulteration of this class of food materials destroyed the market for all farm-made syrups. At present little sorghum syrup is produced, but the sorghum plant is much grown for fodder. Its most valuable characteristic is its ability to withstand protracted drouth. It is therefore especially adapted to the western edge of the humid region, where it is exceedingly popular. Sorghum is also very generally grown in all the southern States, where the fodder is particularly valuable as a feed for the plantation mules. In all the cotton-growing States, as well as along the edge of the great plains, sorghum is a much more certain crop than corn (maize). Kansas is the leading State in the production of this crop. Some varieties are grown as far north as Minnesota and North Dakota. In the South two or three cuttings may be made in a season.

Several varieties of Kafir corn (non-saccharine sorghums) have become established in this country in recent years. The plant resembles a low-growing, branching, very leafy sorghum. It is cultivated either for fodder or for grain, of which latter it yields abundant crops. The grain is inferior to corn, but its more certain yield in dry seasons renders it a valuable crop in the same sections where sorghum is grown. It is rather more distinctly a southern crop than sorghum, being grown most largely in Kansas, Oklahoma, Texas, and New Mexico. Milo maize is not very widely known in this country, but it is gaining a foothold in parts of Texas, where it is grown after the manner of sorghum and is said to furnish large crops of valuable fodder or hay. Teosinte (*Euchlenea mexicana*) is a tropical plant somewhat resembling sorghum, but in reality more closely related to corn (maize). It does not produce seed in this country, but on rich alluvial soils in the southern States it produces enormous yields of green fodder much relished by cattle. It is of no account on poor thin soils. Near the cities, where dairying is an important industry, this crop is of great value in the South. It may be cut several times in a season, and there is no waste in feeding it, as the stalks are readily eaten.

Pearl millet may be classed with the sorghums on account of its manner of growth, but botanically it is quite different from them. It is a native of Africa, and was introduced in this country about 30 years ago. It has been tried very generally over the country, but has never gained favor. The seed is frequently unreliable, and the stems are inclined to be woody when approaching maturity.

A large number of our wild grasses have more or less economic importance. In fact, a majority of them furnish food for domesticated animals, while some are important for other reasons, as will appear in the discussion below. Only a few, however, are of sufficient importance to warrant their mention here. It is somewhat remarkable that none of our wild grasses have been domesticated during the past hundred years. This is perhaps due to the fact that the best of them were brought into cultivation very early in the history of the country. The more important genera of our wild grasses are:

Andropogon.— This genus is particularly well developed along the eastern edge of the western plains, where several species form important constituents of the immense acreage of wild hay cut in that region; also in the southern States, where it constitutes the major part of the growth of grasses in open woods and abandoned fields. *A. virginicus* is one of the most abundant grasses from Maryland southward. These grasses are large and coarse, and are not much relished by stock except in the early stage of their growth, whence the common practice of burning over the prairies to start a new growth of tender grass.

Agropyron.— This genus is particularly characteristic of the northern Rocky Mountain States, where several species are valuable for forage. They are, as a rule, better relished by stock than

the preceding, and some of them furnish hay of excellent quality. *A. occidentale* is the well-known blue-stem of the mountain regions and the western margin of the plains. It has strongly creeping rootstocks, and is perhaps the best hay grass among the wild species in the region where it grows. There is reason to believe that it will in time constitute an important crop on cultivated lands, particularly in the moister valleys of the northern portion of the arid region. *A. divergens* is the common bunch grass of eastern Washington and Oregon and northern Idaho. It is valuable on the ranges, and furnishes very good hay where the rainfall is 20 inches or more. *A. repens* is the well-known quack grass of our northern States. On account of its great development of rootstocks it is a very pernicious weed. Yet it furnishes fairly good forage, and is recommended by some for cultivation in the semi-arid region. It also has some value as a sand binder. *A. tenerum,* the slender wheat-grass of the northwestern prairies, is a good hay grass, seed of which may now be had on the markets.

Ammophila.— A genus of one species, known as beach grass; in Australia and South Africa called "marram." This is as yet the only species of grass that has been used successfully in northern latitudes as a sand-binding grass on dunes near the coast. For this purpose it is invaluable. Extensive plantations of it have been made on both the Atlantic and Pacific coasts; also on dunes near the Great Lakes. It is propagated by digging up bunches of the grass, separating each one into several small bunches, and then resetting them in the sand.

Arundinaria.— The cane of the southern cane-brakes, a relative of the Oriental bamboos. It is much utilized as winter forage for cattle, which frequently winter in good condition in the brakes. There are two closely related species, the larger one furnishing the common cane fishing rods.

Avena.— *A. fatua,* the wild oats of the spring-wheat producing States, is a weed in wheat fields. In several States the common hay is cut from patches in wheat fields taken by wild oats. If cut early enough the hay is of fair quality. Wild oats form an important constituent of the forage on the ranges of portions of the State of California.

Bouteloua.— This is one of the most characteristic genera of the arid regions of America, particularly in the Southwest. Side oats grama (*B. curtipendula*) is a handsome and valuable grass on the plains, where it furnishes much valuable feed. Blue grama (*B. oligostachya*) is the buffalo grass of the plains of eastern Montana, and is also a valuable forage plant.

Bulbilis.— Buffalo grass (*B. dactyloides*) is probably the most valuable wild grass of the plains region, extending from the Dakotas and Montana to southern Texas and New Mexico. It is one of the most nutritious grasses, rivaling Kentucky bluegrass in this respect, but is less productive than the latter. In Texas and elsewhere there were formerly vast areas of buffalo grass forming a compact sod; but owing to overstocking, and the depredations of prairie dogs, the grass is now much less in evidence. It is not well adapted to use on cultivated land because of its poor seed habits.

Calamagrostis.— An important genus along the northern border of the United States. Bluejoint (*C. canadensis*) is an important constituent of swamp hay, of which a large acreage is cut in Minnesota, Iowa, and adjacent States.

Cenchrus.— Two species of *Cenchrus* are found in sandy soils in the South and West. They are noted for the hard spiny "burs" in which the seed are found. They are known as "sand burs," and are pernicious weeds in sandy soils.

Setaria (*Chætochloa*).— The foxtail grasses. Two species, the yellow foxtail and green foxtail, are useless weeds which spring up in wheat fields after harvest.

Distichlis.— Salt grass (*D. spicata*) is common in salt water marshes on the coasts, and on alkali soils in the arid regions. It has some value as a forage plant.

Elymus.— This is a large and important genus. Several representatives are widely distributed, and some possess considerable value as forage plants. *E. condensatus* (giant rye grass) is a very characteristic grass in lowlands in the arid regions, where it grows in large clumps, attaining a height of 6 or 7 feet. While not greatly relished by stock, it frequently suffices to sustain life during periods when other grasses are covered by snow. It has been sown on cultivated land in some irrigated lands of the West, particularly where alkali has begun to appear, and it furnishes large crops of hay. This hay is rather too laxative for horses, but is said to make good feed for cattle. *E. triticoides* (wild wheat) is found in great abundance on wet meadows in eastern Oregon and adjacent regions, where it is frequently cut for hay. The forage is said to be excellent. *E. canadensis* is a very variable species, common throughout the central and northern States. Some forms of it are characterized by strongly developed rootstocks, and thrive in the sandiest soils. It probably has considerable value for holding embankments in places where the soil is sandy. It is also a good forage grass, and is worth more attention than it has yet received for this purpose in the semi-arid region.

Festuca.— One of the characteristic genera of the western States. *F. ovina* (sheep's fescue) is one of the most abundant and most valuable grasses of the ranges in the mountain regions.

Hordeum.— Squirrel-tail grass (*H. jubatum*) is common on the plains of the West, particularly in the north. When young and tender it is eaten by stock. When mature, its rough beards are often injurious to stock; they penetrate into wounds in the mucous membrane of the mouth and into crevices in broken teeth, and often cause the death of horses and cattle. *H. murinum,* a species found on the Pacific coast, has barbed beards which penetrate the skin of young animals. It is a most pernicious pest.

Muhlenbergia.— A genus particularly well developed in the South, where several species of it are usually found in moist or shady places. Nimble Will (*M. diffusa*) is one of the commonest species. A genus of no particular value.

Panicularia.— Four species of *Panicularia* are common swamp grasses of the northern States. They are all excellent forage grasses, but are little utilized, since they seldom grow in situations that permit them to be harvested.

Panicum.— One of the largest and most important genera of grasses in the United States, particularly prominent in the southern States.

Several species have already been noticed in the list of tame grasses above. These are crab grass, Colorado grass, Japanese millet, and the broom-corn millets. The most prominent remaining species are: *P. amarum,* a grass with long creeping stems, common on sands near the coast from Connecticut to Florida and along the Gulf coast. This species is of considerable value for holding drifting sands. *P. capillare,* Old Witch grass, tickle grass, an annual with widely branching panicles, common and sometimes troublesome as a weed in cultivated ground. *P. maximum,* Guinea grass, introduced into Florida from the tropics. A valuable fodder plant, furnishing several cuttings in a season, sometimes confused with Johnson grass, but much less hardy. *P. proliferum,* sprouting crab grass, growing in much the same region as crab grass, but extending farther northward. It springs up in cultivated fields in late summer, and is occasionally utilized as pasture or hay. *P. virgatum,* switch grass, ranging from Maine to the Gulf and westward to the Rocky Mountains. It is a perennial, 3 to 5 feet high, and, if cut very early, furnishes a large yield of fairly good hay. It deserves attention as a hay and pasture grass in semi-arid regions.

Paspalum.— Another large and important genus. Seeds usually in digitate spikes resembling those of crab grass. Carpet grass (*P. compressum*) is a valuable pasture grass near the Gulf coast, particularly on sandy soils. On such soils it will even drive out Bermuda when closely pastured. Its spreading stems form a dense carpet-like growth which gives it its popular name of "carpet grass." Water grass (*P. dilatatum*) is another common grass in all the southern States, frequently found in wet lands. Its seed has recently been placed on the market, and it is used to some extent as a hay and pasture grass. Knot grass (*P. distichum*), with creeping stems, is also common in the South, where it is frequently mistaken for Bermuda, which it closely resembles. Said to be valuable on wet lands as pasture.

Phalaris.— One of the species of this genus (*P. arundinacea*), known as "reed canary" grass, is one of the most thoroughly cosmopolitan species in this country. It is found all over the country, usually on wet or overflowed land, but frequently on uplands as well. It is a perennial with creeping rootstocks (underground stems) growing 4 to 6 feet high. Few grasses are better relished by stock, either as hay or as pasture; and, were it not for its habit of shedding its seeds the moment they are mature, it would undoubtedly have become an important cultivated grass long ago. *P. canariensis* is the well-known canary grass, seed of which is commonly used as food for canary birds.

Poa.— This is one of the most characteristic genera of this country, some representatives of it being well-nigh universal, except in the far South. Kentucky bluegrass, the June grass of the northern States, one of the most important grasses in America, has been fully discussed under the tame grasses above. Many varieties of this species are found in the wild state in the Northwest, where it is of great importance as a range grass. Even in the region of its greatest importance it is a semi-wild plant, springing up everywhere from seed scattered by the wind or by stock. It is the finest pasture grass in the world, but not the most productive. *P. annua* is another representative of the genus found all over the country. It is particularly common in the South and on the Pacific coast, where it remains green during the entire winter. This species is not native here, but is fast becoming one of our commonest grasses. It is frequently found in lawns, and in cultivated grounds. It seldom attains a height of more than a few inches. Texas bluegrass (*P. arachnifera*) is noted for the cottony appearance of its seed. It is also a valuable grass for winter pasture in the South, but is somewhat difficult to establish in a pasture. Like Bermuda, it is usually propagated by setting small pieces of the sod a foot or two apart each way. It is a native of Texas, but is nowhere very abundant. Many species of Poa are found in the far Northwest, where they are important range grasses. *P. laevigata* is frequently cut for hay on wet meadows in the mountain regions of Oregon and Washington.

Savastana.— Vanilla grass (*S. odorata*), commonly called "sweet grass" in the Northwest, is found from New England to Oregon and Washington. It is noted for its strong vanilla-like odor, resembling the odor of sweet vernal grass. The dried leaves are used by the Indians in weaving small mats and boxes, in which condition they retain their characteristic odor.

Spartina.— Cord grass (*S. cynosuroides*) is an important constituent of the swamp hay of which large quantities are cut in Minnesota, Wisconsin, and Iowa. It is frequently found in large areas growing alone, as if it had been sown there by hand. The hay is of fair quality, and the yield large.

Sporobolus.— Another characteristic genus of the West and Southwest, where several species are important on the ranges. Saccaton (*S. wrightii*) is common in Arizona and New Mexico, where it grows in large clumps, and is frequently cut for hay. Although decidedly coarse, the hay is valued as forage. Dropseed (*S. cryptandrus*), common on the western plains and in the Rocky Mountains, is much relished by stock.

Stenotaphrum.— A single species, *S. dimidiatum,* is of importance. It is frequently used as a lawn grass from Charleston, S. C., southward. Sometimes called Charleston lawn grass and Mission grass. This is the pimento grass of Jamaica. In New South Wales it is called buffalo grass. It grows on all kinds of soils, from heavy clay to almost pure sand, but is seldom found far from the seashore.

Stipa.— A large and important genus in our western flora. Several species are remarkably long-awned on the flowering glumes, giving them the popular designation of needle grasses. Some of them have the lower end of the seed produced into a hard, sharp joint which frequently penetrates the skin of animals, rendering these species somewhat of a nuisance to stockmen. Many of them, however, make excellent hay on the great plains. *S. leucotricha* is the bearded mesquite of central and southern Texas, a valuable wild hay grass. *S. vaseyi,* found in the Rocky Mountains at altitudes of 5,000 to 6,000 feet, has the peculiar property of inducing sleep in stock that eat it, for which reason it is known as "sleepy grass." No harm, further than a desire to sleep, seems to follow a feast on this grass; the effects wear off gradually in a day or two.

Uniola.— One species (*U. latifolia*) has large panicles of broad, drooping spikelets, rendering it exceedingly graceful. It is used as an ornamental, and is indeed one of the most beautiful of the grasses. It is found from Pennsylvania westward to Illinois and southward. *U. paniculata,* seaside oats, grows abundantly on the sands of our southern Atlantic coast, and on the Gulf coast, where it serves as a sand binder.

Zizania.— Wild rice; Tuscarora rice. Wild rice (*Z. aquatica*) is one of the most striking in appearance of any of the American grasses. It occurs on mud flats almost all over the country. It is very abundant on the tide flats of the Delaware and Potomac rivers, as well as in many other places both in the United States and Canada. A field of it in bloom presents a very pleasing appearance with its large, graceful panicles, yellow below with a great wealth of staminate flowers in drooping branches of the panicle, the upper, pistillate branches rising gracefully at various angles. When found in situations that permit it to be harvested, Indian rice is cut for forage, yielding enormous quantities of succulent feed much relished by stock. The seed is gathered in quantity for food by Indians in the northern States and in Canada. It is frequently planted in mud or shallow water for its seed, of which fish and birds are exceedingly fond. The seed is gathered in boats, into which it is threshed from the tall stems growing in water. The seed keeps best under water.

Ornamental Grasses.— A number of valuable ornamental grasses have been mentioned above. A few others deserve notice. Reed (*Arundo donax*) is found in door yards in nearly all parts of the country, particularly in the South, though it thrives quite well at the North. It frequently attains a height of 15 feet or more. It resembles sorghum, but is more leafy and more graceful in appearance. It is a perennial, springing up in early spring from the roots. As a background for smaller ornamental plants it is invaluable. Many of the bamboos are exceedingly useful as ornamental plants. Only a few species are adapted to northern latitudes. A garden variety of *Phalaris arundinacea* is common in this country under the name of ribbon grass. Its leaves are striped with white. There is also a similar striped variety of reed. *Coix lachryma-jobi,* Job's tears, is a small to medium-sized grass frequently found in gardens and door yards; it is noted for the indurated, tear-shaped covering of the seed. *Eulalia japonica* of the Orient, *Erianthus ravennæ* (Ravenna grass) of Italy, and *Gynerium argenteum* (Pampas grass) of the Argentine pampas are other well-known and deservedly popular ornamental grasses.

W. J. Spillman,
Agrostologist U. S. Department of Agriculture.

Grass'hopper-frog, or **Cricket-frog,** a small agile, noisy frog (*Acris gryllus*), common throughout the warmer half of the United States, whose spring cry is like the rattling produced by striking rapidly together two resonant pebbles. It is about an inch long, brown with a blackish triangular patch on the back of the head and a dorsal stripe. Its eggs are attached in little masses to a blade of marsh-grass.

Grasshoppers and Locust-plagues, insects of comparatively large size of the orthopterous families *Acridiidæ* and *Locustidæ,* or short-horned and long-horned grasshoppers respectively. In Great Britain and her colonies the former are the "locusts" of popular speech, and only the *Locustidæ* are called "grasshoppers." For the allied family of crickets, see Gryllidæ. The *Acridiidæ* have the antennæ shorter than the body and blunt, the ovipositor short and its parts divergent at the tip, and the sound-producing organs (see Orthoptera), on the hind thighs and outer edge of the forewings. In the *Locustidæ* the antennæ are long and tapering, the ovipositor long and sword-like, and the sound-organs are at the inner base of the forewings. This latter family embraces the katydids, tree-crickets, green meadow-grasshoppers, and certain western species erroniously called "crickets," and the group is more particularly treated under Katydid. In both families the hinder legs are greatly enlarged, enabling the insects to make the long leaps so characteristic of them; their wings are also capable of carrying them in some cases many hundreds of miles.

The short-horned grasshoppers are those of greatest interest economically, and those responsible for the "locust" plagues of Africa, Arabia, and southern Asia, as also in our West. From time to time vast bodies of certain species sweep from one region to another in swarms many square miles in area and so dense as to darken the sun, feeding on grasses and herbage, and consuming not only crops and pasturage as if by fire, but stripping bushes and trees of foliage and even of the bark. In the ancient world such visitations, which frequently extended into central Europe, caused extensive local famines, sometimes resulting in the loss of hundreds of thousands of human beings and vast numbers of grazing animals. Such "plagues" lasted for two or three years, the hosts breeding numerously at first, but gradually dying out and ceasing to reproduce outside the limits of their permanent breeding-grounds. The reproduction of grasshoppers consists in the deposit in autumn of eggs laid in bunches, covered with a secretion which hardens into a case or "pod," beneath the surface of the ground, into which the ovipositor is deeply thrust, and where the eggs remain to be hatched the following spring; in warm countries, however, two generations may take place annually. The locusts referred to in Scripture belonged probably to the species now named *Schistocerca peregrina,* of North Africa and Arabia. The swarms which from time to time appear in South Africa are of *Pachytylus migratoroides;* while *P. migratorius* is the best-known one of southern Europe and Asia. Similar species inhabit the open interior regions of both North and South America, a species of *Acridium* afflicting Argentina.

Of the many species in the United States those of the genus *Melanoplus* are of greatest interest because frequently destructive of crops. The most conspicuous is *M. spretus,* the Rocky Mountain locust, which has been a scourge of agriculture west of the Mississippi River ever since settlements began there. Among the more recent great plagues were those of 1856 and 1874, the latter enduring three years and causing widespread ruin throughout the whole region between the Mississippi River and the Rocky Mountains. The federal government appointed a commission of entomologists to investigate the habits of the insect, and its three 'Reports'

(1877, 1879, and 1882) are exhaustive essays on the subject. It was found that these and other destructive locusts bred throughout the whole plains region in the river bottoms and sunny depressions, and that little could be hoped for in defence except the gradual effect of cultivation in destroying the eggs and young by late and early plowing. This effect has been gained with unexpected celerity; and troublesome grasshoppers now breed in considerable numbers only in northern Idaho and central British Columbia. Swarms occasionally migrate and do damage, but the extensive plagues of the past will probably not recur. Nevertheless, grasshoppers are likely often to be locally harmful in the West, and must be combatted intelligently. The most valuable preventives are the burning over or deep plowing of breeding grounds, so as to turn the eggs out and kill them in the fall or before they can hatch in the spring. The grasshoppers themselves may be captured by means of "hopper-dozers" or kerosene pans. A cheap destroyer consisting of one part of Paris green thoroughly mixed in 60 parts of fresh horse-dung, two pounds of salt to half a barrel of the mixture being added, after being dissolved in water. This mixture is scattered broadcast along the edges of crops where infestation is feared, and the locusts, liking and eating the poison, die a few days later. The ordinary bran-arsenic mixture for cut-worms may also be used, and in some regions wheat fields are protected by a trap-crop of rye sown in a strip around the fields and poisoned by spraying with Paris green.

Consult: Sharp, 'Insects' (Vol. VI., Cambridge Natural History 1900); Howard, 'The Insect Book' (1901); and publications of the United States Department of Argiculture, especially Bulletin 25, Division of Entomology.

Grass'quits, a group of interesting little seed-eating finches of the West Indies, belonging mainly to the genus *Sporophila,* and flocking in grassy lands and pasturage.

Gra'tian, or **Gratianus Franciscus,** Benedictine writer of the 12th century. He was a native of Chiusi, and is considered the founder of the science of canon law. He was the author of a famous work, entitled 'Decretum; or, Concordia discordantium Canonum,' in which he endeavors to reconcile those canons that seem to contradict each other. It is a rich storehouse of the canon law of the Middle Ages. The best edition of the text is found in the 'Corpus Juris Canonici' of Richter (1833–9).

Gratian, or **Gratianus,** grā-shĭ-ā'nŭs, Roman emperor; eldest son of the Emperor Valentinian: b. Sirmium, Pannonia, 359 A.D.; d. Lyons 383. When only eight he was raised by his father to the rank of Augustus. On the death of Valentinian in 375 the eastern part of the empire still remained subject to Valens, and Gratian was obliged to share the western part with a half-brother, a child of four years, associated with him under the title of Valentinian II. In the early part of his reign the Goths and Alemanni made incursions into the Danubian provinces and into Gaul. They were repeatedly defeated by Gratian and his generals, but they also advanced into the eastern empire, and defeated and killed Valens in 378. Gratian then bestowed the eastern empire upon Theodosius, one of his generals.

Gratiola, grā-tī'ō-la, a genus of scrophulariaceous plants with many species widely distributed in temperate regions. A notable representative is the European hedge-hyssop (*Gratiola officinalis,* which is extremely bitter, acts violently as a purgative, diuretic, and emetic, and in overdoses is an acrid poison. It was formerly highly esteemed as a medicine, and its virtues were supposed to depend on a bitter resinous principle called "gratiolin."

Grattan, grăt'an, **Henry,** Irish orator and statesman: b. Dublin 3 July 1746; d. London 4 June 1820. He was called to the Irish bar in 1772, and in 1775 was elected member for Charlemont in the Parliament of Ireland. He immediately became distinguished in the opposition, and infused that spirit into the country which produced in 1782 a repeal of the statute of 6th George I., which had enacted that the crown of Ireland was inseparably connected with that of Great Britain; that Ireland was bound by British acts of Parliament when named therein; that the Irish House of Lords had no jurisdiction in matters of repeal; and that the last resort in all cases of law and equity was the British House of Lords. For his share in the acquirement of this concession the Irish Parliament voted him £50,000 and a house and lands for him and his heirs forever. He became the leader of the country party in the House of Commons, and the head of the Irish Whigs. Disgusted by the Irish rebellion and its manifold horrors, he temporarily seceded from Parliament, but the project of a union being brought forward by Pitt, he once more obtained a seat in Parliament for the purpose of opposing it. When it was carried, however, he did not refuse a seat in the United House of Commons, being returned in 1805 for Malton in Yorkshire, and in the following year for Dublin. His later years were chiefly occupied in a warm and energetic support of Catholic emancipation. Grattan was the zealous friend of Ireland from first to last. As a public speaker he had to contend with a defective voice; but his eloquence was bold and commanding, combining strength with beauty, and energy and elevation with elegance. The best collection of Grattan's parliamentary speeches is that edited in 1822 by his son Henry, who also wrote an account of his 'Life and Times' (1839–46). See Lecky, 'Leaders of Public Opinion in Ireland' (1871); Dunlop, 'Henry Grattan' (1889).

Gratz, Rebecca, American educator: b. Philadelphia 4 March 1782; d. Philadelphia 27 Aug. 1869. Of a family noted for wealth and culture, she showed her bent of mind by founding in 1838 in Philadelphia the Hebrew Sunday-school, the oldest society of its kind in America, and for 32 years she was at its head. Apart from her labors in behalf of the Jewish poor and needy, she was quick to respond to the claims of charity without regard for creed, and she was long regarded as Philadelphia's representative Jewess for her simple piety, personal charm, and social standing. Her name will always be associated with Scott's 'Ivanhoe,' for once when Washington Irving was visiting Sir Walter Scott and learned that a Jewess was to be introduced in the latter's novel, then in course of preparation, the American described Rebecca Gratz with so much warmth — she was a dear friend of his betrothed, Miss Hoffman, whose

early death produced such poignant grief—that Scott was deeply impressed. When 'Ivanhoe' was finished he sent the first copy to Irving, with the inquiry whether the «Rebecca» of romance compared favorably with the «Rebecca» of reality. Miss Gratz's portrait is preserved, after a painting by Thomas Sully, in John Sartain's 'Reminiscences of a very Old Man' (D. Appleton & Company 1900).

Grau, Maurice, American operatic manager: b. Brunn, Austria, 1849. He came to the United States with his parents in 1854; was graduated from the New York College in 1867, and from Columbia Law School. From 1872 until 1903 he was the most prominent operatic manager in America, securing a long line of singers, musicians, and actors, including names so diverse as Aimée, Rubinstein, Salvini, Sarah Bernhardt, Patti, Irving, Coquelin, Jane Hading, Mounet-Sully, Mme. Rejane. As director of the Maurice Grau Opera Company, he brought some of the most famous singers of the day to America.

Grau, Miguel, mē-gĕl' grow, Spanish-American admiral: b. Piura, Peru, 1834; d. 1879. After studying in the naval school at Callao he entered the Peruvian navy as a midshipman in 1852. In 1871 he was put in command of the turret ship Huascar and in the Chilean war of 1879 was killed by the explosion of a shell while engaged with two ironclads of the enemy.

Graubünden. See GRISONS.

Gravatt, William Loyall, American Protestant Episcopal bishop: b. Port Royal, Va., 15 Dec. 1858. He was educated at Virginia State College and Virginia Theological Seminary. Deacon's orders were conferred upon him in 1884 and he was advanced to the priesthood in 1885. In 1899 he was consecrated bishop of western Virginia.

Gravel. See CALCULUS.

Gravel-root. See EUPATORIUM.

Gravelotte, gräv'lŏt, **Battle of,** one of the most severely contested and most important conflicts of the Franco-German war (q.v.). It is named after a village of Lorraine, seven miles west of Metz, but is also called by the French the battle of ST. PRIVAT, and of GRAVELOTTE and REZONVILLE. After the disastrous defeats at Wörth and at Forbach on 6 Aug. 1870 the French in two armies, one under MacMahon and one under Bazaine, retreated along the line of the Moselle, their object being to join forces at Châlons. To prevent this the first German army under Prince Frederick Charles intercepted Bazaine by a circuitous march, forced upon him the battle of Courcelles and Mars-la-Tour, and compelled him to keep within touch of Metz. On 18 August the armies of Prince Frederick Charles and Steinmetz, numbering about 211,000 troops under the command of King William, attacked the position. Bazaine had taken position with about 111,000 men around Gravelotte to the west of Metz. By a flanking movement the Germans captured St. Privat and defeated the French attempt to break through at Gravelotte. After nine hours' desperate fighting, in which the Germans lost over 28,000 men and the French over 12,000, the latter were forced to retreat into Metz, which was immediately invested by Prince Frederick Charles, and capitulated two months later on 27 October.

Graves, Anson Rogers, American Protestant Episcopal bishop: b. Wells, Rutland County, Vt., 13 April 1842. After being graduated at Hobart College, he took a course at the General Theological Seminary 1870. When the missionary district of Platte (now designated the missionary district of Laramie) was constituted in 1889, he was consecrated first bishop 1 Jan. 1890.

Graves, Frederick Rogers, American Protestant Episcopal bishop: b. Auburn, N. Y., 1858. He was graduated at Hobart College (1878), and the General Theological Seminary (1881). His ministry has been devoted to work in China, he having been ordained for the foreign missionary field, deacon in 1881 and priest in 1882. His consecration as bishop of Shanghai took place in 1893. He has published several works in Chinese.

Graves, John Temple, American journalist and orator: b. Wellington Church, Abbeville District, S. C., 9 Nov. 1856. He was graduated at the University of Georgia in 1875. He is generally classed with Henry Grady as an orator and leader of patriotic sentiment in the South. He has been on the staff of the Atlanta *Journal* since 1892, and is an advocate by pen as well as by voice of a separation between the white and colored races in the United States.

Gravitation. The law of gravitation is the law discovered by Newton, according to which every portion of matter attracts every other portion with a force directly proportional to the product of the two masses, and inversely proportional to the square of the distance between them. The motion of the planets round the sun in ellipses, each marking out the area of its orbit at a constant rate, and each having a year proportional to the square root of the cube of its mean distance from the sun, implies that there is such a force on each planet exactly proportioned to its mass, directed toward, and inversely as the square of its distance from the sun. The lines of force radiate out from the sun on all sides equally, and always grasp any matter with a force proportional to its mass, whatever planet that matter belongs to. Since the force is always proportional to the mass acted on, and produces the same change of velocity whatever that mass may be, the change of velocity tells us nothing about the mass in which it takes place, but only about the mass which is pulling. If, however, we compare the accelerations due to different pulling bodies, as for instance that of the sun pulling the earth with that of the earth pulling the moon, or if we compare changes in motion due to the different planets pulling each other, then we can compare their masses and weigh them one against another and each against the sun.

All this was clearly seen by Newton, and was set forth in his 'System of the World' (3d ed., p. 41). Kepler (q.v.) had indeed given the laws, deduced from observation, according to which the planets describe their orbits. From these Newton deduced the laws of the force in the case of the planets; and subsequently he generalized the statement of them, by showing the identity of the nature of the force that retains the moon

in her orbit, and that which attracts matter near to the surface of the earth. Kepler's laws state, first, that every planet revolves round the sun in an ellipse, of which the sun occupies one focus; second, that the velocity of any planet at different parts of its orbit is such that the radius vector from the sun to the planet sweeps over equal areas in equal times; and third, that the distances of the various planets are so related to the periods of their revolution that the squares of the periodic times are proportional to the cubes of the mean distances from the sun. From these laws Newton made the following deductions: He inferred from the second law that the planet is acted on by a central force that is always directed toward the sun. From Kepler's first law he deduced the law of variation of the force for any one planet, and found that the force varies inversely as the square of the distance of the planet from the sun. Lastly, he concluded from Kepler's third law a relation between the forces on the various planets; namely, that the forces on equal masses of the different planets are inversely proportional to the squares of the distances of those planets from the sun. This law indicates the identity of the nature of the force that acts on the different planets. Newton next proceeded to consider the motions of the moon; and to ask the question, "Is not the force that causes the moon to fall toward the earth the same as that which influences falling bodies near to the earth's surface?" This question he attempted to put to the test of calculation. At first he was unsuccessful. The then received estimate of the dimensions of the earth were so far from correct that the comparison between the force of attraction in a stone and that in the moon at her distance from the earth did not exactly agree with his theory, and he was obliged to give it up for nearly 20 years. It was not till 1684, when he heard a paper of Picard read at the Royal Society of London, on new geodetical measurements of the earth, that he obtained accurate data to work with; and, returning home, he set to work to examine the question afresh.

Newton saw that a mountain mass might be used, and weighed against the earth by finding how much it deflected the plumb-line at its base. The density of the mountain could be found from specimens of the rocks composing it, and the distance of its parts from the plumb-line by a survey. The deflection of the vertical would then give the mass of the earth. Not long after Newton's death the mountain experiment was actually tried. The honor of making the first experiments on gravitation belongs to Pierre Bouguer (q.v.), whose splendid work does not appear to have received the credit due it.

Having established the law of gravitation throughout the solar system, it was natural to infer the universality of its action. We know on the one hand, by observing the motion of the planets and satellites, the asteroids, and the comets, that the law holds with great exactness for all these bodies; on the other hand, experiments of Cavendish with balls of lead, and of others, verify its exactness down to very short measurable distances: and though we are unable with our present appliances to determine the orbits of double stars and of other stellar systems, still we seem to be fully justified in assuming that in these cases also the law stated above holds, at least, very approximately.

The track was first laid down by Newton, based on astronomical observations, and only made firmer and broader by every later observation. Important work in Europe has recently been done in gravitational experiments by the late Prof. U. Jolly, and by Profs. Braun, Boys, and Poynting, who, with others, have advanced beyond the results of Henry Cavendish (q.v.), whose device, known as the Cavendish experiment, for determining the density of the earth, has so long interested scientists. The latest research has verified Newton's celebrated guess that "the quantity of the whole matter of the earth may be five or six times greater than if it consisted all of water."

No inquiry on gravitation has showed that it is related to anything but the masses of the attracting and the attracted bodies. It appears to have no relation to physical or chemical condition of the acting masses or to the intervening medium. This independence of gravitation of any quality but mass, bars the way to any explanation of its nature or source.

There is a point respecting the law which is almost universally passed over without notice, although it is one of the most important questions with respect to the construction of any theory to account for gravitation; namely, the exact proportionality of the gravitating forces of any two bodies to their masses. The most delicate experiments show no deviation from the exactness of this law; nor has the most accurate observation of planetary bodies sufficed to detect any such deviation. This is the fact proved by the well-known guinea-and-feather experiment, in which it is shown that though a mass of gold and a feather do not fall equally fast under ordinary circumstances, because of the unequal resistance of the air in the two cases, yet that, the air being removed by means of the air-pump, they fall with equal velocity. The experiment proves that the force of gravity in the two cases is exactly proportional to the mass of the guinea and of the feather. Newton showed the same thing himself with far greater minuteness by vibrating balls of various materials similarly suspended. In this, which is known as Newton's pendulum experiment, it is shown that pendulums of equal length vibrate in equal times whatever be the material and the masses of which the bobs of the pendulum are made. By this experiment, when performed with all the nicety at command, it is probable that any deviation amounting to a ten-thousandth or a hundred-thousandth part of the whole amount considered could be detected. Planetary motions prove the law to even a greater degree of accuracy. It is curious that this portion of the law, though it is only proved by experiment and observation, is hardly ever, if ever, referred to by popular writers. It is either assumed without pretense of proof, or is passed over without remark.

Notwithstanding the vast interest and importance of the study which this subject presents, and all the labors of eminent scientists in endeavors to solve its complex problems, it still remains to be said that the world is yet without any theory which can really be considered as explaining gravitation. Consult **Mackenzie**, 'The Laws of Gravitation' (1900).

Revised by Simon Newcomb.

Gravity, in physics, the terrestrial gravitation, the operation of the law of gravitation on the earth, specially in making heavy bodies fall in all parts of the planet in the direction of its centre. Newton (q.v.) and Bessel have shown that in a vacuum a sovereign and a feather will fall with equal speed, though the rate will be different in the atmospheric air. The attraction of the whole earth, considered as a sphere, on a body at its surface, is the same as if the whole matter of the earth were collected at its centre. The attraction of the earth on a body within its surface is the same as if the spherical shell situated between the body and the earth's surface was removed; or is the same as if all the matter situated nearer to the earth's surface than the body was collected at the centre, and all the matter situated at a greater distance was removed. The weight of a body is proportioned to the attraction which it exerts, hence gravity in many cases means simply weight (q.v.).

Gravity, Specific. See SPECIFIC GRAVITY.

Gray, Asa, American botanist: b. Paris, Oneida County, N. Y., 18 Nov. 1810; d. Cambridge, Mass., 30 Jan. 1888. He was graduated at the Fairfield Medical College in 1831; but had already acquired a taste for natural science which led him to abandon the practice of medicine for the study of botany. The flora of the United States was by no means well known and classified at that period, and many botanical problems were to be solved by the attainment of new data in his chosen science. He had attracted notice so early as 1834 and was appointed botanist to the Wilkes Exploring Expedition, which was so dilatory in starting that he resigned the position in 1837, and in 1842 was elected Fisher professor of natural history at Harvard University. Between the resignation of his post as botanist to the Wilkes Expedition and his acceptance of the chair at Harvard, he took the opportunity of traveling over Europe, where he made many social and scientific friends and in England met Dean Church of St. Paul's, London, then Fellow of Oriel College, Oxford, with whom he kept up a correspondence of the most intimate friendship until his death. Both were many-sided men of keen intellect and reverent minds. From 1842 to 1873, when he retired from his professorate at Cambridge, the life of Gray is to be read in his published works. He gradually developed the reputation of a botanist of the first rank, one of the greatest of his century, and certainly the greatest his country had ever produced. His lot was cast at a point in the history of science when the artificial system of botany was to pass away, and the new and natural method was to undergo development. There were vast masses of new material constantly pouring in from the newly explored middle western Territories, together with the rich spoils that government expeditions were bringing by sea from the Pacific coast. Prof. Gray, with the assistance of Dr. John Torrey (see TORREY, JOHN), set about to arrange these multitudinous specimens in accordance with the newest methods; to identify, name and classify them. His work was to be called the 'Flora of North America,' and was to be a comprehensive history of the botany of the country upon a classification basis of natural affinity. This work was not completed beyond the order of *Compositæ,* as the constant accessions of new specimens rendered the portions already published out of date, and proved that the attempt at so colossal an undertaking would be premature before all the material was in, and every specimen had been deliberately examined and classified. Yet Gray's pen could not be idle, and he published volume after volume in which he showed he was as clear and concise as an exponent of botany in its elementary principles, as he was skilful and bold in wide generalizations and profound analysis. His scientific position was that of a theistic evolutionist. He dissented from Darwin's opinion that variation was the result of fortuitous contingencies. He was a teleologist and believed that species were differentiated according to a preordained plan in the mind of a creator, and he was of the spirit that could subscribe to evolution and yet repeat the Catholic creed. His principal writings are as follows: 'Elements of Botany' (1836); 'Structural and Systematical Botany' (1879); 'Manual of Botany for the Northern United States' (1848); 'Genera Boreali-Americana Illustrata' (1849); 'Botany of the United States Exploring Expedition under Captain Wilkes' (1854); 'Plantæ Wrightianæ Texano-Neomexicanæ' (1853); 'Darwiniana, Essays and Reviews Pertaining to Darwinism' (1876); 'Synoptical Flora of North America' (1884); 'Natural Science and Religion' (1880); published posthumously, 'Scientific Papers of Asa Gray' (1889); and 'Letters of Asa Gray' (1894).

Gray, Barry. See COFFIN, ROBERT BARRY.

Gray, David, American journalist: b. Buffalo, N. Y., 8 Aug. 1870. He was graduated from Harvard in 1892, entered journalism in 1893 as a reporter and editorial writer for the Rochester *Union and Advertiser,* became managing editor of the Buffalo *Courier* in 1897, and after a course in law was admitted to the bar in 1899. He has published 'Gallops,' a collection of fox-hunting sketches reprinted from the 'Century.'

Gray, Elisha, American inventor: b. Barnesville, Ohio, 2 Aug. 1835; d. Newtonville, Mass., 21 Jan. 1901. During his attendance at Oberlin College his skill in handicraft enabled him to support himself by carpentry. He left college to apply himself to the improvement of electrical apparatus; and in 1867 received his first patent for a self-adjusting telegraph relay. He subsequently invented the telegraphic switch and annunciator for hotels, the telegraphic repeater, the private telegraph line printer, etc. The litigation between him and Alexander Graham Bell, both of whom claimed to be inventors of the telephone, resulted in a verdict in favor of the latter, whose rights were sustained by the Supreme Court. The telautograph, by which written messages were to be sent over the telephone or telegraph, was patented by him in 1893. For many years he was engaged practically in the manufacture of electrical apparatus in Chicago and Cleveland and founded the Gray Electric Company in Highland Park, Ill. The Congress of Electricians at the World's Columbian Exposition was organized by him in 1893, and he was elected to preside at its sittings. Among his writings the most notable are: 'Experimental Researches in Electro-Harmonic Telegraphy and Telephony' (1878); and 'Elementary Talks on Science.'

Gray, Henry Peters, American painter: b. New York 23 June 1819; d. there 12 Nov. 1877. He was a pupil of Daniel Huntington in 1838, and after several years abroad he established himself in New York, and was president of the National Academy 1869–71. Among the most important of his works are: 'Wages of War,' now in the Metropolitan Museum; 'The Judgment of Paris'; 'Cupid Begging his Arrows'; 'Apple of Discord'; 'Blessed are the Pure in Heart,' an illustration of Irving's 'Pride of the Village'; 'Hagar and the Angel.'

Gray, Horace, American jurist: b. Boston 24 March 1828; d. Nahant, Mass., 15 Sept. 1902. He was graduated from Harvard in 1845, from the Harvard Law School in 1849; studied law also in the office of Judge Lowell; was admitted to the bar in 1851, and in 1854–61 was reporter of the Massachusetts supreme court. At the same time he became a leader of the Massachusetts bar, in 1864 was appointed an associate justice of the State supreme court, and in 1873–81 was chief justice. While on the Massachusetts bench he rendered numerous important decisions in connection with the exemption of the United States from suit, ancient boundaries and grants, the law of charities, the effect of war upon private rights, and other matters, and gained an extensive reputation for the force and clearness of his style. In 1881 he was appointed to the Supreme Court of the United States, and this post he held until his resignation in 1902. His views upheld a broad construction of the Constitution and of Federal power, as for example, in his opinions regarding the insular cases which resulted from the acquisition of new domain by the United States government. Other opinions concerned the civil law of Louisiana, the conflict of laws, United States jurisdiction over the Guano Islands, and the exemption of Federal property from State taxation. It is stated that his dissenting opinions were comparatively few.

Gray, John Chipman, American legal authority, Royall professor of law at Harvard from 1883. He also practises law in Boston, and among his published works may be mentioned: 'Restraints on the Alienation of Property'; 'Select Cases'; 'Rule Against Perpetuities'; 'Cases on Property.'

Gray, John Purdue, American alienist: b. Half Moon, Pa., 1825; d. Utica, N. Y., 29 Nov. 1886. He was graduated from Dickinson College in 1846 and took a medical degree at the University of Pennsylvania in 1848. He was successively assistant physician and medical superintendent of the New York State Asylum at Utica. He introduced many improvements into the treatment of the insane, and was for many years editor of the 'American Journal of Insanity.'

Gray, Joshua, American inventor: b. Sheffield, Vt., 4 May 1824; d. Medford, Mass., 25 June 1899. He received a common school education; became connected with the Manchester (N. H.) Locomotive Works, and while there designed a system of quick-steaming boiler tubes. His other inventions include the rubber-tipped lead pencil, a breech-loading magazine rifle, a seven-armature dynamo, a railroad signal, and a sewing-machine shuttle.

Gray, Maxwell. See TUTTIET.

Gray, Robert, American discoverer: b. Tiverton, R. I., May 1755; d. Charleston, S. C., 1806. In 1787 he was appointed to the command of the sloop Washington, equipped by Boston merchants for trade with the Indians of the Pacific coast. He returned in the Columbia in 1790, and, proceeding by way of Canton, was the first to carry the United States flag around the earth. During a second voyage he discovered the Columbia River, which he named from his ship. He was subsequently in command of trading vessels.

Gray, William Crane, American Protestant Episcopal bishop: b. Lambertville, N. J., 6 Sept. 1835. He was graduated at Kenyon College (1859); ordained deacon in 1859 and priest in 1860. He was consecrated bishop of southern Florida in 1892.

Gray, Thomas, English poet: b. London 26 Dec. 1716; d. Cambridge 30 July 1771. He was educated at Eton, where he was intimate with Horace Walpole, and St. Peter's College, Cambridge. He quitted college in 1738, traveled on the continent and returned to England in 1741. His father soon after died, and leaving but a small property, Gray returned to academic retirement at Cambridge. Here he continued for several years, occupying himself with forming magnificent literary schemes, which he admirably commenced but wanted energy to mature. So slow was he to publish, that it was not until 1747 that his 'Ode on a Distant Prospect of Eton College' made its appearance; and it was only in consequence of the printing of a surreptitious copy that, in February 1751 he published his 'Elegy Written in a Country Churchyard,' which went through four editions in two months. In 1757, on the death of Cibber, the office of laureate was offered to Gray, who declined it, and next year he published his two Pindaric odes, 'On the Progress of Poesy,' and 'The Bard.' These odes have never been popular, but many critics of high reputation have expressed the warmest admiration for them. In 1768 the Duke of Grafton presented him with the professorship of modern history at Cambridge; in consequence of which he wrote the 'Ode for Music,' for the installation of that nobleman as chancellor of the university the following year. He was buried with his mother in the churchyard of Stoke Poges, in Buckinghamshire. As a poet, Gray is lofty, energetic, and harmonious. As a writer of Latin verse he is surpassed by few, and his letters published by his friend Mason in 1775, are admirable specimens of his epistolary style. In his private character he was of a friendly and affectionate though somewhat fastidious disposition, which gave an air of effeminacy and timidity to his manners, subjecting him to much ridicule. His general acquirements were uncommon, but his want of energy and perseverance rendered his extensive research little effective. In 1884 a complete edition in four volumes of Gray's works, both prose and verse, with nearly 350 letters, was published by E. W. Gosse. See Gosse, 'Life of Gray' (1882); Ward, 'English Poets' (Vol. 3).

Gray Duck, the gadwall (q.v.).

Gray Whale (of California). See RORQUAL.

Grayback, the name, in popular speech, of several animals strikingly gray in color, as the

gray whale (see RORQUAL); the knot (q.v.) and certain other shorebirds; or a body-louse. See LOUSE.

Graybeard Moss. See USNEA.

Graydon, James Weir, American inventor: b. 18 Jan. 1848. He was graduated at the United States Naval Academy; served during the Civil War period in the Federal army under Sherman and Grant; was later promoted lieutenant in the navy, and resigned. His inventions include a dynamite gun; the Graydon gigantic wheels; an aërial torpedo; a cable system of torpedoes, and a railway carriage heater, all bearing his name.

Grayhen. Feminine of BLACKCOCK (q.v.).

Graylag Goose. See GEESE.

Grayling, A fish of the family *Thymallidæ*, much resembling a slender salmon, 15 to 18 inches long, and formerly included in the salmon family. Some five species of the single genus *Thymallus* are known, all inhabitants of northern regions, in rapid streams where the water is clear and cool, and the bottom sandy or pebbly. Its habits are similar to those of trout, except that it spawns in the spring. Its flesh is excellent, with an odor and flavor, when fresh, of wild thyme. It is caught by fly-fishing as for trout, and is a favorite with anglers. Two species are known in North America, each with so limited and scattered a distribution that they are regarded as modified relics of a preglacial circumpolar species. The Arctic grayling, or «poisson bleu» (*T. signifer*) of the fur-hunters, inhabits only the Mackenzie basin and rivers in Alaska. The more southerly and familiar grayling (*T. tricolor*) is restricted to certain streams in northern Michigan, where it is almost extinct, and seems incapable of recovery by fishcultural methods; and to Montana. These fish are distinguished from trout or salmon by the large size of the dorsal fin and by their grayish hue, with half-a-dozen deep blue spots on the fore part of the abdomen. Consult: Pritt's 'Book of the Grayling' (London 1888); and Jordan & Evermann's 'American Food and Game Fishes' (New York 1902).

Gray's Inn, one of the four Inns of Court, in London, situated on the north side of Holborn and to the west of Gray's Inn Lane. It contains a hall of the period of 1560. It derives its name from the noble family of Gray of Wilton, whose residence it originally was.

Gray's Peak, a peak in the Colorado range, in Colorado, and one of the highest in the Rocky Mountains. Its height is 14,341 feet. It was named in honor of Asa Gray, the botanist.

Gray'weather, or **Graywether,** a sandstone of the Tertiary strata scattered over the surface of the ground in Dorsetshire and Wiltshire, England. It was from these stones that the famous druidical circles were built.

Grease-bug, or **Overflow-bug,** a groundbeetle (*Platynus maculicollis*), common in California, and occasionally a pest in houses because of its disagreeable odor when crushed, and because it nibbles bread and meats.

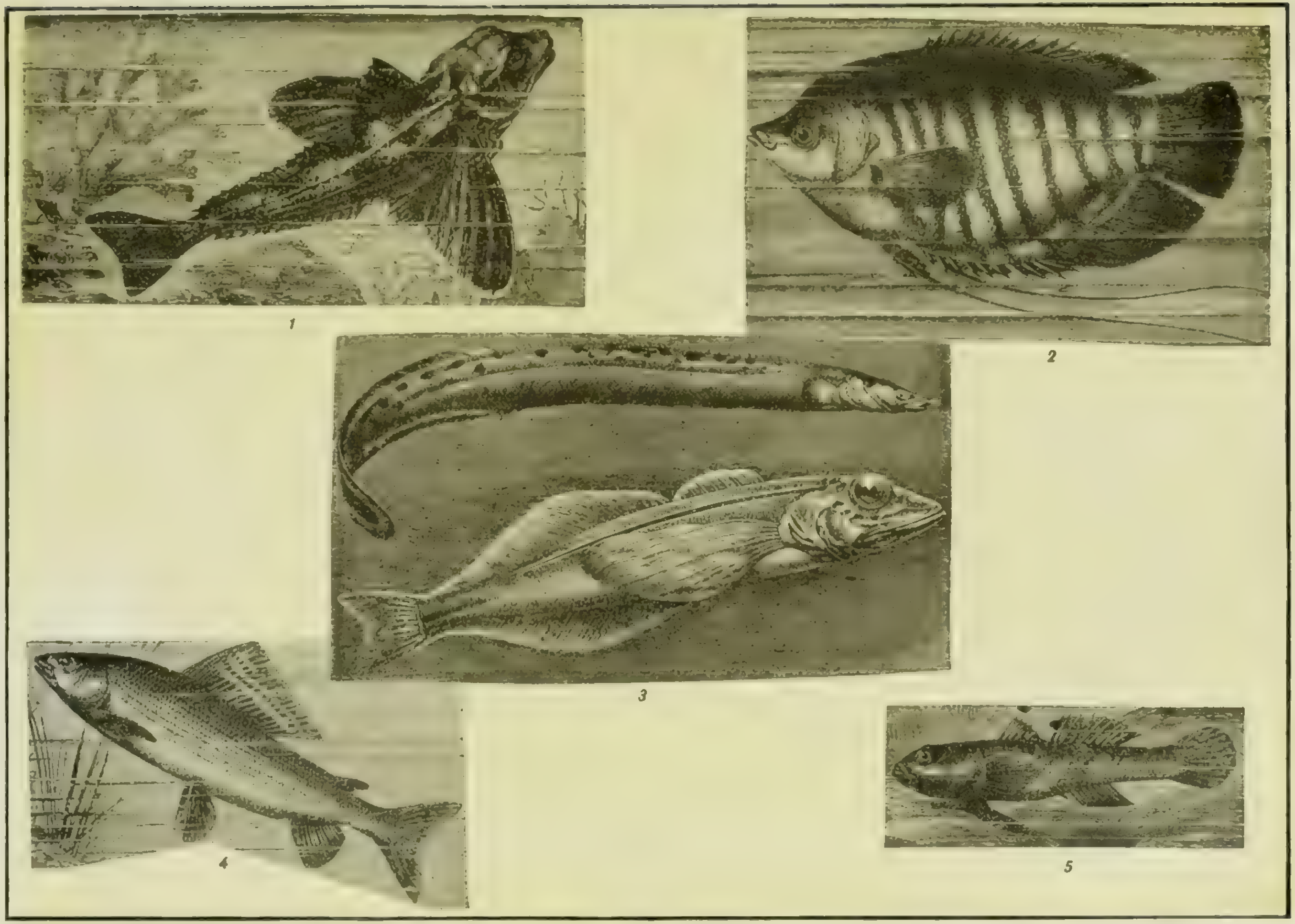
Greasewood, a small, very thorny, almost leafless shrub (*Sarcobatus vermiculatus*) of the goosefoot family (q.v.), which abounds among the sage-brush on the arid plains of the western United States, especially where the soil is saline. The wood, which is yellow and very hard and tough, frequently supplies the only fuel available there, and burns with a bright hot crackling blaze suggesting grease.

Great Auk. See GAREFOWL.

Great Awakening, the popular name of a great and tenacious «revival» in New England, 1740–5, under the influence of Jonathan Edwards and George Whitefield. Edwards had created a similar excitement in Northampton five years before, the embers of which were still glowing, but on Whitefield's visiting him in the fall of 1740, and preaching his thrilling sermons in addition to Edwards', the wave spread all through New England, involving over 150 towns, and rising almost to frenzy. It was marked by the extremest accompaniments of bodily seizures, convulsions, hysteria, etc., and aimed especially to bring young children under its control. Edwards was rightly considered its author, and was fiercely denounced for its irrationality and evil effects on public worship, as well as the temporary ruin of calm and fruitful work; he defended it for some time, but its results at last came to be deplored even by its champions, and by 1742 it was threatening not only the peace but the life of the churches. So bad were its effects that to the reaction has been attributed the religious deadness of the country for the next 60 or 70 years. The separation of the «converted» into an arrogant clique who often seceded in separate churches, the upspringing of a horde of ignorant lay preachers making physical effects the touchstone of religion, the indecent rivalry in «manifestations,» the denunciation of all the trained ministry as lacking divine grace, were only a part of its demoralizing outcomes. The faculties of Yale and Harvard colleges pronounced against it, as did the leading divines; the Massachusetts General Convention of 1743 added its testimony, and in Connecticut an effort was made to enforce the Saybrook Platform against the independence of congregations.

Great Barrington, Mass., town in Berkshire County, on the New York, N. H. & H. R.R.; 40 miles west of Holyoke. In the town are three villages: Great Barrington, Housatonic and Van Deusen. It was settled in 1725, but formed a part of Sheffield until 1761. William Cullen Bryant was town clerk for several years, and the thoughts in many of his poems were suggested by the beautiful Berkshire scenery. The town has a good public library, the Hopkins Memorial Manse, the Sedgwick Institute, and a number of good elementary schools. The manufactures are cotton goods, electrical apparatus, and paper. Pop. 5,872. Consult: Taylor, 'History of Great Barrington.'

Great Basin, a vast region of interior drainage, a triangular plateau of North America, occupying the western part of Utah, and nearly the whole of Nevada, parts of Oregon and California, and extending at its northeast angle into Idaho. It is bounded on the west by the Sierra Nevada and on the east by the Wasatch Mountains. The base of the triangle at the north is 500 miles from east to west, and the extent from north to south is 800 miles. The area is about 210,000 square miles, a little larger than France. It is traversed by numerous mountain ranges, irregular in arrangement; the



1. Gurnard (Trigla hirundo). 2. Gourami (Osphromenus olfax).
3. Indian Spring Eel (Mastacembelus armatus), above; and Golomynka or Oilfish of Lake Baikal (Comephorus baikalensis), below.
4. Grayling (Thymallus thymallus). 5. European Goby (Gobius fluviatilis).

valleys are mostly sinks, the chief drainage centre being Great Salt Lake (q.v.). The areas of greatest depression are to be found near the borders, and the greatest elevation near the central part. The highest range is the East Humboldt, one peak of which, Mount Bonpland, is 11,321 feet in height. Volcanic masses form or conceal the original rocks of many of these ranges. The slopes and the geological markings show that the lakes and rivers which once existed within this region have become smaller and some have disappeared. The greater portion of this section was once in the basin of the Columbia River. The Great Basin contains many streams and lakes (the latter for the most part salt) whose waters never reach the ocean, but are either taken up by evaporation or their waters sink in the desert sands. The mean annual rainfall ranges in different localities from 4 to 15 inches. The plateau is nearly destitute of trees, and in general only the upper parts of the valleys are clothed with desert shrubs, their lower portions often being covered with muddy water or with several inches of alkaline salts left by evaporation. The chief arid places are the Great Salt Lake Desert, the Mohave Desert, and the Carson Desert. This Basin is rich in mineral wealth; gold, silver, iron ore, and copper exist here in large quantities.

The Great Basin is among the large interior drainage sections of the world; but the interior drainage basin of Asia is 23 times as great, and the Sahara 16 times as great.

Great Bear Lake. See BEAR LAKE, GREAT.

Great Bend, Kan., city, county-seat of Barton County; on the Arkansas River, the Missouri P. and the A., T. & S. T. R.R.'s; about 92 miles northwest of Wichita. The Central Normal College is located here. It is a trade centre for the surrounding agricultural region, and contains flour mills and iron works. Pop. 2,500.

Great Bridge, Va., Battle at, 9 Dec. 1775. Lord Dunmore, royal governor of Virginia, hearing that a patriot force from North Carolina was on the way to occupy Norfolk, the largest town in Virginia and its chief port, built a rough fort at Great Bridge, over the Elizabeth River, commanding the southern approach. The Virginia patriots raised a band of sharpshooters, including John Marshall, afterward Chief Justice of the United States Supreme Court, took possession of the opposite bank, and in a 15-minute fight, which cost Dunmore 61 regulars and the militia none, forced him to abandon the fort. A few days later the Virginians occupied Norfolk, which the spiteful governor set on fire before taking refuge in a war-ship in the harbor. The town was reduced to ashes.

Great Britain, Britain, or **Britannia,** was the name applied by Cæsar and other Roman writers to the island of Great Britain, Aristotle having referred to the *Nesoi Bretannikai* (British Isles) as early as the 4th century B.C. According to Rhys, Britannia has nothing to do with the Welsh *brîth,* "spotted, tattooed," from which it is commonly derived; the only Celtic words of the same origin are the Welsh vocables *brethyn,* "cloth," and its congeners; in which case the Britons may have styled themselves "cloth-clad," in contradistinction to the skin-wearing neolithic nation that preceded them. Britannia was a poetical or rhetorical expression till in 1604 James I. styled himself king of Great Britain; the term was proposed so early as 1559 by the Scottish Lords of the Congregation.

History.— The history of Great Britain is practically the history of England, with the added historical facts concerning Scotland and Ireland. Under the articles ENGLAND, SCOTLAND, and IRELAND will be found the histories of these respective countries. While specifically comprising England, Wales, and Scotland, and with Ireland forming the United Kingdom of Great Britain and Ireland, the designation Great Britain is commonly employed to indicate the United Kingdom and its colonial possessions. The history of the expansion and growth of Great Britain and the development of her colonies will be found in the various articles on AUSTRALIA, CANADA, INDIA, and of other parts of the British Empire.

Constitution.— The British constitution is in nearly every important respect unique. It is a conspicuous instance of gradual evolution, resulting in the end in the creation of a system of law and government superior in comprehensiveness, in stability, in elasticity, to any of the numerous constitutions drawn up on what were supposed to be the most enlightened and logical principles. One of the best examples of the characteristically English development of important institutions entirely outside of written law or formal legislative enactment is the position occupied by such a body as the cabinet, a body never officially recognized by any act of Parliament, and wholly unknown to the written law, yet practically the highest executive body in the kingdom, though nominally the executive government is vested in the sovereign. The English constitution does not exist written in any single document, nor even in a few or in many documents; much of it, indeed its most vital and important part, is based on custom hardened into inviolable precedent, and is in a sense unwritten. The principal sources of British constitutional law have been arranged under four heads, namely: (1) Treaties or quasi-treaties; (2) the precedents and customs known as common law; (3) compacts; and (4) statutes. The last is at the present day practically the only method by which the British constitution may receive additions and modifications, and to its scope there are no theoretical limitations. The treaties of constitutional importance are the Act of Union with Scotland, passed in 1707, and the Act of Union with Ireland, passed in 1800, each consisting really of two statutes, and these created the United Kingdom and the Imperial Parliament. The second source, customary law, though unwritten in a sense, is now embodied in a mass of judgments, opinions of eminent lawyers, and other similar documents. It includes — and this is most characteristic of English institutions — many of the most important matters of public polity, such as the organization and inter-relations of the Crown, cabinet, lords, and commons. The compacts refer to the powers of the Crown considered as distinct from and opposed to the nation, and include the Great Charter of 1215, the Bill of Rights of 1689, and the Act of Settlement of 1700, which have been called "the title-deeds of English political liberty." They have something of the character of ordinary statutes, but differ

in the peculiar part played by the king in respect to their provisions. The great extension of the franchise brought about by recent statutes and the introduction of voting by ballot have had the effect of giving the constitution far more of a democratic character than formerly, with what result in further legislation remains to be seen. The existence of a body of hereditary legislators is objected to by many, but the question of "ending or mending" the House of Lords can hardly as yet be said to have become an important one.

The Sovereign.— Under the title of a constitutional and hereditary monarchy the government of Great Britain is vested in the sovereign and the two houses of Parliament — the House of Lords and the House of Commons. The fundamental maxim upon which the right of succession to the throne depends is that the crown is, by common law and constitutional custom, hereditary, and that the right of inheritance may from time to time be changed or limited by Parliament; under which limitations the crown still continues hereditary. It descends to the males in preference to the females, strictly adhering to the rule of primogeniture. The sovereign is of age at 18 years. The heir to the crown has, since the time of Edward III., inherited the title of Duke of Cornwall, and receives that of Prince of Wales by letters patent. The power of the sovereign is limited by the laws. The divine right, so obstinately maintained by the Stuarts, was never recognized by the nation, and William III., Mary, and Anne ascended the throne, according to express declarations, only by virtue of a transmission of the crown to them by the nation. One of the most important attempts to override the law by the authority of the crown was the abuse by James II. of the dispensing power, an infringement of the ancient liberties of the realm which was one of the chief causes of the revolution of 1688. The maxim has, however, been acknowledged, particularly since the Restoration, that there is no power in the state superio the royal prerogatives; the acts of the king are therefore subject to no examination, and the king is not personally responsible to any tribunal; hence the maxim, "The king can do no wrong." Yet there is sufficient provision for confining the exercise of the royal power within the legal limits. (1) All royal acts are construed in accordance with the laws, and it is taken for granted that the king can never intend anything contrary to law. (2) The counselors of the king are responsible for the royal acts, and, as well as all those who are concerned in the execution of them, are liable to impeachment and examination, without the right of defending themselves by pleading the royal commands. (3) The Parliament and the judicial tribunals have also the right to discuss freely such royal acts, and, in particular, Parliament and each individual member of the upper house, has the right to make remonstrances to the Crown. (4) Individuals are protected from any abuses of the royal power by the Habeas Corpus Act of 1679, the liability of the agents to prosecution, the right of complaining to Parliament, recourse to the courts of justice, and the liberty of the press.

The king is the supreme head of the state in peace and war, the lord paramount of the soil, the fountain of justice and honor, and the supreme head of the Church. The supreme headship of the Church as belonging to the sovereign dates only from the ecclesiastical changes of Henry VIII.'s reign. The king also has the prerogative of rejecting bills in Parliament, which, however, has not been exercised for some 200 years. As the generalissimo, or the first in military command within the kingdom, he has the sole power of raising and regulating fleets and armies, which, however, is virtually controlled by the necessity he is under of obtaining supplies from Parliament. As the fountain of justice, and general conservator of the peace of the kingdom, he alone has the right of erecting courts of judicature, and all jurisdictions of courts are derived from the crown. As the fountain of honor, of office, and of privilege, he has the power of conferring dignities, privileges, offices, etc. In the foreign relations of the nation he is considered the nation's representative, and makes treaties, declares war, etc. As advisers he has the privy council and the cabinet. In the cabinet are included all the greater officers of state, such as the first lord of the treasury, the secretaries of state for foreign affairs, for the home department, for the colonies, and for India, and others, and thus the cabinet is in reality at the head of the administration. Consequently it forms a link between the legislative and executive departments of the state, as above pointed out. See Edward VII.; Victoria.

Parliament.— The origin of the upper house of the British Parliament has been sought rightly enough in the Witenagemôt (literally "meeting of the wise men") or national assembly of the Anglo-Saxons, which under some of the kings had much the character of a royal council. In a somewhat different form, due to its adaptation to feudal territorial conceptions, the Witenagemôt was continued in the Norman times. Gradually, however, the Great Council, as the Witan was called under the Norman kings, began to divide into sections, owing to the great increase in its business which took place after the Conquest. Its judicial functions were step by step separated from its legislative and executive and its financial work, and from this separation, begun under Henry I., greatly advanced under Henry II., and completed in its main features under Edward I., arose several of the leading elements in the British national constitution. The exchequer represents the Great Council as the supreme financial body, the courts of king's bench, common pleas, etc., continue its judicial functions, the privy council retains in part its administrative character, while the House of Lords, though retaining a small portion of the judicial authority of its progenitor, mainly performs another function virtually inherent in the Great Council, that of legislation. For the origin of the lower house, or House of Commons, we must look to the old shire courts, which originally dealt only with local affairs, but latterly sent elected representatives to a central body to act for them in national affairs, and especially to provide the necessary taxes. When the boroughs increased in importance and numbers they were similarly represented; and in De Montfort's Parliament of 1265 there appeared representatives not only of the greater barons, including the greater ecclesiastics, but also of the shires and of the boroughs. In the Parliament summoned by Edward I., 30 years later, the same mode of representation was car-

ried out in a more thorough manner. The shire and borough representatives, though at first distinct, gradually coalesced, and thus the Parliament came to be regarded as including three estates, now known as the lords spiritual, the lords temporal, and the commons.

In the reign of Edward III. (1327–77) the separation of the estates into two houses — the House of Lords, consisting of the lords spiritual and the lords temporal, and the House of Commons, consisting of the knights, citizens, and burgesses — became settled, though the time at which the Commons began to sit as a separate assembly is not definitely known. The upper house is thus an older institution than the lower. All the peers were not originally entitled to a seat as a matter of right, but only those who were expressly summoned by the king. Every peerage of the United Kingdom conferred now, however, gives the right of a seat in the House of Lords or upper house. The number is indefinite, and may be increased at the pleasure of the Crown, which, however, cannot deprive a peer of the dignity once bestowed. The upper house at present comprises about 580 members. By the act of union with Scotland, 16 representatives of the Scottish peerage are elected by the Scottish nobility for the duration of each Parliament, and 28 are elected for life by the peers of Ireland. No parliamentary measure can become a law till it has passed the House of Lords as well as the House of Commons. In the upper house the lord-chancellor presides, holding the position of the speaker in the Commons, with this difference, that he has the right to take part in debate as an ordinary member of the House. All grants of subsidies or parliamentary aids must originate with the House of Commons, and the Lords have not the right to amend, but only to accept or reject, a money bill.

The Parliament is not permanent, and it is the royal prerogative to summon and dissolve it. As the Parliament is summoned, so it is prorogued, by the royal authority. A dissolution of Parliament is effected either by the authority of the Crown or by length of time. The House of Commons being chosen but for seven years, at the expiration of that time Parliament is dissolved *ipso facto*. The lower house of Parliament has the direction of all financial concerns; and there is perhaps no subject which may not be brought before it by petition, complaint, or motion of a member. The upper house is the supreme court of judicature in the nation. In civil cases (as now represented by the lords of appeal in ordinary) it is the supreme court of appeal from the superior tribunals of the three kingdoms. In indictments for treason or felony, or misprision thereof, where the accused is a peer of the realm, the House of Lords are the judges of the law and the fact. In cases of impeachment by the House of Commons the House of Lords are also the judges. All the forms of a criminal trial are then observed, and the verdict must be by a majority of at least 12 votes. The House of Commons is in no sense a court of law, and, powerful as it is, it cannot revise, amend, or in any way interfere with a judgment duly given in a court of law.

Parliamentary Reform.— The House of Commons in the first Parliament of Henry VIII. consisted of 298 members, a number largely increased by royal charters and by the Acts of Union, which gave 45 members to Scotland and 100 to Ireland. Just previous to the Reform Bill of 1832, therefore, it consisted of 658 members, of whom 513 were from England and Wales, 45 for Scotland, and 100 for Ireland. In this representation there were great injustices and anomalies. Many of the boroughs had quite fallen into decay, so that a place like the famous Old Sarum, which consisted only of the ruins of an old castle, sent two members to Parliament, while great manufacturing towns like Manchester and Birmingham were absolutely without representation. Not only the rotten boroughs, as these decayed constituencies were called, but also in many cases the towns, in which the right of suffrage belonged to a small number of freeholders, were practically in the hands of a single family, and in this way a few great houses — Norfolk, Bedford, Devonshire, and the Pelhams, etc.— commanded more than 100 seats in Parliament. For the few places that were in the hands of independent voters a shameless system of bribery existed, in spite of the prohibitory laws, and the prices of votes were generally well known: a seat for a small place cost about $25,000. This state of matters led to long-continued agitation for parliamentary reform, and ultimately, on 1 March 1831, Earl Grey being then premier, Lord John Russell introduced a plan of reform proposed by the government. On the 22d the English bill passed its second reading in the Commons by a majority of one, but the government suffered defeat in committee on a proposal not to reduce the number of members for England and Wales. A dissolution followed, but the Whigs again came into power under the same prime minister, and on 24 June Lord John Russell brought his second Reform Bill before the newly elected House. This bill, in which the proposed diminution of the number of English members was abandoned, finally passed the Commons on 21 September by 349 to 236, but was rejected by the Lords by 199 to 158. On 6 December, when Parliament met after the prorogation, a third Reform Bill was introduced by Lord John Russell, and passed the Commons on 23 March 1832. In the upper house the government was defeated on an amendment proposed by Lord Lyndhurst, whereupon Earl Grey asked the king either to create sufficient new peers to carry the bill, or to accept his resignation. The latter alternative was adopted, and the Duke of Wellington undertook the impossible task of forming an anti-reform ministry. On 18 May the Whigs were reinstated with the assurance of being provided with the means of passing the bill, and finally it passed the Lords by 106 to 22, owing to the absence of many of the opposition, who did not want to force the creation of new reform peers. The royal assent was given on 7 June. The Reform Bill of 1832 brought great changes. Occupiers of lands or tenements in counties at yearly rent of not less than $250, and occupiers as owner or tenant of a house or shop in a borough of a yearly value of $50, now received the franchise. Fifty-six rotten boroughs were wholly disfranchised; 30 boroughs were deprived of 1 member; and 1 borough (Melcombe-Regis cum Weymouth, which had 4) of 2 members; 22 boroughs were created in England to return 2 members each, and 20 boroughs to return 1 member each. Besides taking away the right of election from many insignificant places, and vesting it in large, or at

least in tolerably populous constituencies in new boroughs, the act introduced something like uniformity in the qualifications of the voters of the old boroughs and cities, and extended the elective franchise from close corporations, or privileged bodies to the citizens at large.

The Reform Bill had not been long in force when a further extension of the franchise began to be demanded. After several unsuccessful attempts by Lord John Russell, Lord Palmerston, and Mr. Gladstone to pass reform bills, in 1867 Mr. Disraeli, then chancellor of the exchequer, succeeded in carrying through a bill which conferred the borough franchise on all householders who had resided in the borough for 12 months previous to the last day of July in any year, and had been assessed for and paid poor rates, and on all lodgers who had occupied for a like period lodgings of the yearly value of $50 unfurnished. In counties the franchise was bestowed on occupiers as owners or tenants of subjects of $60 ratable value, and the copyhold and leasehold franchise was reduced from $50 to $25. This bill related only to England and Wales, but bills of a similar character were passed for Scotland and Ireland in the following year. In this way the electorate, which was 1,352,970 in 1867, rose to 2,243,259 in 1870, but the total number of members still remained at 658. To Manchester, Liverpool, Birmingham, and Leeds were assigned 3 members each, and to London University 1. Populous counties were further divided, and to many of the divisions 2 members each were given. This act, though in some ways it did not effect so great a change as that of 1832, is of even greater importance, since it may be regarded as marking the beginning of the present democratic system of representation.

From the union of Scotland with England in 1707 till 1832 the former returned 45 members to the House of Commons, 30 for the 33 counties, and 15 for 15 districts or burghs. Superiors, or persons holding directly from the Crown, alone voted in the counties. In two counties there were only three real voters in each. The number of persons who actually voted at the elections of the burghs was very inconsiderable, consisting, in general, of the magistrates and town council, amounting only to 20 in each burgh, or in all the 66 burghs to 1,320. By the Scotch Reform Act of 1832, 9 members were added to the representation; Edinburgh and Glasgow receiving 2 each, and Aberdeen, Dundee, Greenock, Perth, and Paisley 1 each. The right of voting was also placed as near as possible on the same footing as in England; but the number of members, though increased, was not in proportion with those allotted to England, or even to Ireland. By the Scotch Reform Act of 1868 the burgh franchise was assimilated to that of England, being conferred on householders, but in counties the occupation tenure was $70 or upward. Seven additional seats were given: 1 to the universities of Aberdeen and Glasgow jointly, 1 to those of Edinburgh and St. Andrews (the university electors being the members of the general councils), 1 to Glasgow city (which now had 3), 1 to Dundee (which now had 2), and 1 each to the counties of Lanark, Ayr, and Aberdeen, which were divided into 2 divisions, each returning a member.

Since the legislative union with Great Britain in 1801 Ireland had sent 100 members to the House of Commons, 64 for the 32 counties, 2 each for Dublin and Cork, 1 each for 31 other cities and boroughs, and 1 for Dublin University. By the Reform Act of 1832, 5 members were added, namely, 1 each to the towns of Belfast, Galway, Limerick, and Waterford, and 1 to the university; and $50 copyholders, etc., were admitted among the classes of county voters. In 1850 occupiers of land rated at $60 a year were admitted to vote. In the borough franchise the $50 qualification for owner or occupant was adopted in the reform of 1832, much the same as in England; and by the act of 1850 the franchise was further extended to $40 occupiers. By the Reform Bill of 1868 the occupation franchise in towns was reduced from $40 to $20, and for lodgers it was fixed at the same as in England and Scotland.

The Representation of the People Act of 6 Dec. 1884, established a uniform householder and a uniform lodger franchise throughout the kingdom, and increased the electorate by about 2,500,000 voters. Equally important changes were effected by the Redistribution Act passed in June 1885. By it 79 small boroughs in England and Wales (including four districts of boroughs in the latter) and 24 in Ireland ceased to return members separately, while in Scotland the Haddington and Wigtown districts of burghs lost the burgh franchise. In England 36 small boroughs, and in Ireland 3, lost 1 member each. The members for Liverpool were increased to 9, for Birmingham, the Tower Hamlets, and Glasgow to 7 each, for Manchester to 6, for Leeds and Sheffield to 5 each, and other important centres in proportion. Thirty-three new boroughs chiefly in the London metropolitan district, were created. Many of the larger boroughs were divided and a member given to each division; large counties were dealt with in a similar way. The numerical strength of the Commons was also raised, the gross number of members being 670, of which England gets 465 (2 additional), Wales 30 (as before), Scotland 72 (12 additional), and Ireland 103 (2 less). The following is a summary of the distribution of members according to the act of 1885:

ENGLAND.	
4 counties with 2 members each, 5 with 3 each, 9 with 4 each, 5 with 5 each, 4 with 6 each, 5 with 7 each, 5 with 8 each, Lancashire with 23, Yorkshire with 26, Rutland and Isle of Wight with 1 each	234
8 cities and boroughs with 1 each, 28 with 2 each, 9 with 3 each, and 5 with 4 each	187
Leeds and Sheffield 5 each, Manchester 6, Birmingham and Tower Hamlets 7 each, and Liverpool 9	39
Universities	5
	465
WALES.	
8 counties 1 each, 3 with 2 each, Glamorgan 5	19
7 districts of boroughs 1 each, Swansea and Merthyr Tydvil 2 each	11
	30
SCOTLAND.	
23 counties with 1 each, 5 with 2 each, Lanarkshire 6	39
16 burghs with 1 each, 2 with 2 eacn, Edinburgh 4, Glasgow 7	31
Universities	2
	72
IRELAND.	
21 counties with 2 each, 8 with 4, 1 with 7, 1 with 1, 1 with 3	85
6 boroughs with 1 each, 2 with 4 each, 1 with 2	16
Universities	2
	103
Total	670

Ranks and Titles.—The laws acknowledge only two distinctions of rank or civil status, the nobility and the commonalty. The distinction is by no means like that between the patricians and plebeians in ancient Rome, nor that between the nobles and citizens of France in the 18th century, and the peculiar privileges of the nobility are few and insignificant. Intermarriages with commoners are usual, and the sons of peers mingle with commoners in the House of Commons, where wealth, talent, and industry are at least as well represented as birth. Moreover, the House of Lords is continually recruited from the general body of commoners by the conferring of peerages on distinguished men. The peers are exempted from the performance of certain unimportant public services, such as sitting on juries, etc. They have also a right to be tried by the House of Lords on indictments for treason, or felony, or misprision thereof; but the administration of justice before this tribunal is as strict as in the ordinary courts. Their persons cannot be arrested in civil cases. The titles borne by those who form the peerage are, in a descending scale, duke, marquis, earl, viscount, baron. Of these, earl is the oldest, this title dating from the Anglo-Saxon period when it was equivalent to that of *ealdorman* or governor of a shire. After the Conquest the title of baron came into use. The barons formed an inferior class of nobles to the earls, though the term was also used to include all tenants-in-chief. The title of duke arose under Edward III., who created his eldest son Duke of Cornwall (1337). The title of marquis was introduced in the time of Richard II.; that of viscount during the reign of Henry VI. It is only the actual holders of these titles who are, strictly speaking, the nobility; their families are only noble by courtesy. The chief privilege that the titles confer is a seat in the House of Peers or — since the term lord is often used as equivalent to peer — the House of Lords. The Scottish and Irish peers sit in the House only by deputation; but many Scottish and Irish peers have also titles belonging to the peerage of Great Britain or the United Kingdom in virtue of which they sit; thus, the Marquis of Lothian sits as Baron Ker. The titles of nobility just mentioned are inherited by the eldest son, who, during the life of the father, as a rule bears by courtesy his next highest title if he is a duke, marquis, or earl; if the father be a viscount or baron, the son is only an "honorable." Any of the sons of a duke or marquis is called lord, but only the eldest son of an earl is so called. Next below the rank of the nobility are the baronets. This dignity was created by James I. in 1611, and descends to the eldest son. There are no privileges annexed to the baronetcy, but the title is considered an honor, and is often bestowed on men who have distinguished themselves in a civil or military capacity. Below the baronets are knights (who also have Sir before their names) and esquires, and all others that may be classed among the gentry. The knights are either members of one of the orders of knighthood, or they are knights bachelors. The term gentry is sufficiently vague, but may be said to include the richer landed proprietors, and all to whom wealth, office, or talents have secured a certain respect and standing in society. All these may be said to have a claim to be considered as of the rank of esquires, which, however, by law is somewhat restricted in its application.

Army and Navy.—The British army is raised on the authority of the sovereign, who is looked upon as its head, and from whom all officers derive their commissions; but the number of troops maintained and the cost of the different branches are regulated annually by a vote of the House of Commons. The maintenance of a standing army in time of peace without the consent of Parliament is prohibited by the Bill of Rights of 1689. From that time onward to 1879 an act called the Mutiny Act was annually passed for regulating the management of the army and enabling the sovereign to frame the Articles of War to serve as the military code. An Army Annual Act is now passed for the same purpose, and the regulations accompanying it contain the military law of the country. Till recently the whole of the military departments of the army were under the commander-in-chief as supreme head, the civil department being under the financial secretary; at present the secretary of state for war exercises control over all departments of the military service of the country, and the heads of departments, whether military or civil, are responsible to him. No British citizen is obliged to bear arms except for the defense of his country, but all able-bodied men from 18 to 30 years of age (with the exception of certain classes) are liable to service in the local militia, the militia being raised when required by ballot. Enlistment among the regulars is either for 12 years' army service (long service) or for 7 years' army service and 5 years' reserve service (short service). The regular army of Great Britain consisted in 1903 of a total of about 219,700 men of all ranks besides about 74,000 serving in India. There were in addition the four classes of reserve or auxiliary forces, namely, the militia, the army reserves proper, the volunteers and the yeomanry cavalry. The grand total of all branches at home and abroad amounted to fully 808,752 men. The volunteer force has been in existence only since about 1859. The British army is small when compared with that of some of the Continental states, but the reverse is the case with the navy, which is to be regarded as the main defense of the empire and its extensive commerce.

Alfred the Great is commonly regarded as the founder of the British navy, but as a permanent establishment its origin is rather to be attributed to Henry VIII. Under him were established the admiralty office and the dockyards of Deptford, Woolwich, and Portsmouth, the personnel of the navy at this time numbering about 8,000 men. Under Elizabeth the strength of the navy was greatly increased, and it continued to advance till at the revolution of 1688 the navy was manned by over 40,000 men. About the middle of the following century there were some 70,000 seamen and marines serving in the navy. The end of the 18th and the early part of the 19th century formed a glorious period in English naval history. In 1814 the navy consisted of some 900 vessels, manned by 146,000 men. After the peace the naval forces were greatly reduced in strength and the number of men employed has never been so great since. The introduction of steam as a propelling power, and of iron and steel as materials of construction, worked an immense change

in the character of the navy. In 1903, including officers, seamen, boys, and marines, there were about 122,500 of all ranks in the British naval service. This includes 4,200 men in the coast guard, or life-saving service. Formerly the navy was under the administration of a lord high admiral, but since the accession of William III. such an official has rarely been appointed, and a board of admiralty has taken his place. This board now consists of six members, at their head being the "first lord," who is always a member of the cabinet, and is responsible for the general direction and supervision of all naval business. Under him are four naval lords (men holding a distinguished position in the service) and a civil lord.

The effective vessels in commission in the British navy, February 1903, were as follows: 21 first-class battleships; 8 second-class battleships; 6 armored cruisers; 60 protected cruisers; and 57 destroyers. The navy has many other vessels launched, under way, or projected, as the following table will show:

Class	Compl'te for sea 1903	Launch'd and Compl't'g	Build'g or Project'd
Battleships, all classes....	45	4	5
Cruisers, all classes......	141	6	12
Gunboats	33	...	4
Destroyers	113	...	19
Torpedo Boats...........	51	...	4
Submarines	5	1	4
Totals	388	11	48

Finances.—The practice of borrowing money in order to defray a part of war expenditure began in the reign of William III. At first it was customary to borrow on the security of some tax, or portion of a tax, set apart as a fund for discharging the principal and the interest of the sum borrowed. This discharge was, however, very rarely effected. The public exigencies still continuing, either the loans were continued, or the taxes were again mortgaged for fresh ones. At length the practice of borrowing for a fixed period, or, as it is termed, upon terminable annuities, was almost entirely abandoned, and most loans were made upon interminable annuities, or until such time as it might be convenient for the government to pay off the principal. Owing partly, perhaps, to the scarcity of disposable capital at the time, but far more to the supposed insecurity of the revolutionary establishment, the interest paid by the government on these loans was comparatively high, and it was, moreover, subject to considerable variation. As the country became richer and the confidence of the public in the stability of the government was increased, ministers were able to take measures for reducing the interest. In the reign of George II. it was determined that the practice of varying the interest should be stopped. Instead of varying the interest on the loan, the rate was generally fixed at 3 or 3½ per cent, the necessary variation being made in the principal funded.

At the time of the death of William III., the public debt, partly by reason of the long wars, amounted to £16,394,702, the public income being £3,895,205. By far the greater part of the next reign also was a time of war, and on the death of Queen Anne the national debt amounted to £54,145,363. The reign of George I. was undisturbed by war, which enabled the government of the time to reduce the debt by £2,053,125, so that at the accession of George II. the whole amount of the debt was £52,092,238. The first 12 years of the reign of the new king were passed in profound peace, but during the latter years of his reign the country was engaged in extensive wars. The total expense of the wars that were carried on between 1739 and 1748 was estimated at £46,418,680, and the cost of the Seven Years' war was £111,271,996. At the conclusion of the Peace of Paris in 1763, after the Seven Years' war, the total debt amounted to £138,865,430. Between the Peace of Paris in 1763 and the outbreak of the American war in 1775 the national debt was again reduced, the amount of the reduction being £10,281,795. Thus, at the outbreak of the American Revolution the national debt was £128,583,635. To this that war added £121,267,993, but above £10,000,000 was canceled between the close and the commencement of the French war, when the debt stood at £239,350,148. During the French war £601,500,343 of new debt was contracted, and on 1 Feb. 1817, when the English and Irish exchequers were consolidated, the total debt was £840,850,491. A considerable reduction was effected between that year and the outbreak of the Crimean war, which again added nearly £33,000,000 to the total, so that in 1857 it amounted to £837,144,597. Since then the debt has been greatly reduced. In 1875 a special act was passed providing for the reduction of the debt, and on 31 March 1901 the whole amount of it was £690,992,622, carrying an annual interest charge of £19,835,489. On 31 March 1902, however, owing to the Transvaal War, the figures were £747,911,107, and annual interest £26,650,000. This includes both a funded and an unfunded debt. The latter species is that for which no formal provision has been made, or for which the provision has proved insufficient, or has not been forthcoming at the time when it was required. The form in which it mostly exists is that of exchequer bills, which bear interest at so much per cent per day, and pass from hand to hand like bank-notes. After a certain time they are received in payment of taxes or other moneys due the government, and the interest due on them is allowed in the payment. These bills were first issued in 1696. There are none now issued under £100, and many are for £500, £1,000, and larger sums. They are frequently converted into funded debt by granting capital in some of the stocks to the holders. In 1902 the total debt was divided as follows: Funded, £609,587,248, terminable annuities, estimated capital value at 3 per cent, £63,190,859; unfunded, £75,133,000; total, as above, £747,911,107; other capital liabilities, £20,532,279; grand total, £768,443,386. Against this might be put certain assets, more especially the shares acquired by Great Britain in the Suez Canal, the market value of which was £27,935,000. The national debt amounts to about £18, 6*s.*, 4*d.* per head of the population, and the annual charge on account of it is about 12*s.*, 8½*d.* per head. See National Debt.

Economic Supremacy.— Sir Robert Giffen estimates the total capital of Great Britain and her colonies at the enormous sum of $110,000,000,000, with an annual income of $16,000,000,000. He divides the capital between the home country and the colonies as follows:

United Kingdom	$75,000,000,000,000
Canada	6,750,000,000,000
Australasia	5,500,000,000,000
India	15,000,000,000,000
South Africa	3,000,000,000,000
Remainder of Empire	6,000,000,000,000

"No such economic force has ever been in the possession of a single state or empire. . . . France and Germany have each probably not more than a third or a half of these figures. . . . They have the beginnings of over-sea empire, but as yet, in comparison with the United Kingdom, beginnings only. . . . The United States alone of all modern states is comparable to the British Empire." Its aggregate income, he places at $15,000,000,000, derived from a capital of $90,000,000,000, and, he adds, "It would not be going too far to say that the two Anglo-Saxon states or empires more than outweigh in economic force the whole of the rest of the world."

Area and Population.— The area and population of the islands forming Great Britain, or as they are better known, the British Isles, are shown in the following table:

Divisions	Area in sq. miles	Population in 1901
England and Wales	58,309	32,526,075
Scotland	29,785	4,472,103
Ireland	32,583	4,458,775
Isle of Man	227	54,758
Channel Islands	75	95,841
Total	120,979	41,607,552

The area and population of the colonies of Great Britain are enumerated under the article British Empire (q.v.).

With regard to occupations and pursuits the census gave the following returns for England and Wales, Scotland, and Ireland: Professional class, 812,242 males, 439,452 females—total, 1,251,694; domestic class, 188,365 males, 2,170-260 females—total 2,358,625; commercial class, 1,616,065 males, 47,795 females—total 1,663,860; agricultural and fishing class, 2,349,652 males, 173,176 females — total 2,522,828; industrial class, 6,641,637 males, 2,383,521 females — total 9,025,158; others, 3,245,676 males, 10,716,413 females — total 13,962,089.

Religion.— In England and Wales the Anglican or Protestant Episcopal Church dominates with 2,004,493 communicants, the number of communicants of all other Protestant dissenting sects being estimated at 1,946,959; the adherents of the Roman Catholic Church are estimated at 1,500,000. In Scotland, the Presbyterian Church is the established form of worship, and in 1901 had 668,335 communicants; the United Free Church, a dissenting Presbyterian body, had 500,000 members; while the Roman Catholics were estimated at 365,000, and Episcopalians, 121,800. In Ireland the Roman Catholic Church is dominant, in 1901 its adherents being returned at 3,308,661, 74.2 per cent of the total population. The number of Jews is about 150,000, of whom nearly three fourths are in London.

Education.—Since 1870 education has made great advances in all the divisions of the United Kingdom. In that year a comprehensive measure (with compulsory clauses) for the promotion of elementary education in England was passed by the state. Its chief provisions were for the election of school boards in districts in which there was a deficiency of school accommodation, with power to build and maintain schools out of rates levied for the purpose, and for the giving of aid by parliamentary grant to these board schools as well as to previously existing schools. As the result of this act the whole country was mapped out into school districts, school boards were established in London and in all the school districts where there was a deficiency of school accommodation, and these school boards were permitted to make a compulsory by-law for their districts. These provisions were supplemented in 1876 by an act which provided that each school district which had no school board should at least have a school attendance committee. In 1900 there were in England and Wales 2,545 school boards, embracing in their operations a population of 20,142,943, and 788 school attendance committees, embracing a population of 8,859,532. The proceedings of these bodies and the manner in which they administer the acts are reported by H. M. inspectors to the education office. The Scotch Education Act, passed in 1872, was from the first a comprehensive measure which required the election of school boards in every burgh and parish, and made school attendance compulsory throughout the country, the school age being from 5 to 14 years. The child, however, can leave school when he has passed the 5th standard and is 12 years of age. It was provided by legislation in 1889 that the elementary education of Scotland should be almost entirely free; and in 1891 enactments were passed to make it entirely free, both in England and in Scotland. In 1897 an act was passed providing for money grants to necessitous voluntary schools. In Ireland, which is still far behind England and Scotland, elementary education is under the superintendence of a body of Commissioners of National Education, created in 1845, with powers to erect and maintain such schools as they thought necessary. There is, however, no compulsory school attendance in any part of Ireland. The Education Acts in England and Wales are administered under the general superintendence of the board of education, established in 1900, Scotland being under a special department. Of the schools in England and Wales in 1900, 5,758 with 2,201,049 pupils in average attendance were directly under school boards, while 11,777 with 1,885,802 pupils were connected with the National Society. The grants to elementary schools were in 1901: England, £8,390,907; Scotland, £1,196,236; Ireland, £1,321,905. Besides these grants the schools have an income from endowments, school fees, local rates, etc. There are a number of training colleges for teachers, organized mostly in connection with the different religious bodies.

Secondary education is divided into five classes, namely, private enterprise, subscribers, companies, endowed, and those under local authority. The total number of schools in 1901 was 6,209. The number of pupils was 291,544. The private enterprise schools numbered 5,167; the endowed, 619. Of the latter class many are known as grammar schools. A special class may be said to consist of the great public schools of Eton, Harrow, Rugby, Winchester, etc. In Scotland there are many higher class schools, and also secondary departments in other schools

under the school boards. Technical education received a great impetus from the passing of various acts from 1889 onward.

For the higher education there are in England the Universities of Oxford, Cambridge, London, Durham, the Victoria University, the University of Wales, and the Birmingham University. In addition to these there are colleges, some of them called university colleges, at Nottingham, Bristol, and other places (some of them for women), and the colleges belonging to the different religious bodies. Till 1900 London University granted degrees, but did not teach; it is now, however, a teaching university, having in connection with and forming schools of it, University College, King's College, and other institutions. In Scotland there are the four universities of Edinburgh, Glasgow, Aberdeen, and St. Andrews; a university college at Dundee incorporated with St. Andrews University; St. Mungo's College, and Anderson's College Medical School, Glasgow. Ireland has the University of Dublin, the Queen's Colleges at Belfast, Cork, and Galway in connection with the Royal University of Ireland (which is merely an examining and degree-conferring body), the Roman Catholic University in connection with Maynooth and other Roman Catholic colleges. A medical education may be obtained at the various universities and colleges, or in connection with the chief hospitals. See CAMBRIDGE; OXFORD, etc.

Climate.— The British Isles being nearly in the centre of the temperate zone, have, in common with all countries so situated, four different seasons, which merge almost insensibly into each other, but exhibit a wide range of temperature between their opposite extremes. The central latitude of the United Kingdom is nearly 55° N., and the isothermal line which passes through it indicates a mean annual temperature of 50°. The chief agents in moderating the climate of the British Isles are the Atlantic Ocean with its warm surface waters drifting from the southwest, and the warm winds which prevail during a large part of the year from the same quarter. While they blow, frost is of rare occurrence, and never of long duration in the British Isles. When the wind blows from the north, after it has passed over immense fields of ice, or from the east, where, from the limited expanse of the German Ocean, its temperature continues nearly as low as that which it had acquired in passing over the Continent, the atmosphere is rapidly cooled down, and frosts are occasionally severe. These considerations explain the only disadvantages under which the British climate labors.

Zoology.—The animals found in Great Britain are for the most part the same as those inhabiting similar latitudes over the whole of the North Temperate or Palæarctic region of the Old World. In fact Wallace says that the majority of genera in countries so far removed as Great Britain and northern Japan are identical. As the British Islands were formerly connected with the Continent, the general similarity is intelligible enough, while the geological changes of insulation and the restriction of area are enough to account for the one great difference that the British, and especially the Irish species, are much fewer than those on the mainland. Insulation, however, also abets the modification of species, and thus we find a few forms peculiar to Great Britain, such as the red grouse (*Lagopus scoticus*), a shrew (*Sorex rusticus*), as well as some land-shells and insects. But if we exclude these few exceptions, and take account furthermore of the extinct forms, the general conclusion is simply that the British fauna resembles that of the corresponding parts of the great Palæarctic region. See works by Wallace, Murray, Heilprin, etc.

Botany.—The British flora corresponds in a general way to that of the Continent, but appears to consist of several more or less distinct sets. The general resemblance may be shown by the fact that out of 117 plants recorded by De Candolle as characteristic of more than a third of the earth's surface, 100 occur in Britain. As to the various sets, Watson in his 'Cybele Britannica' (1847) distinguishes British, English, Scottish, Highland, Germanic, and Atlantic types; while Forbes (Mem. Geol. Soc., i. 336) also considered the vegetation of Great Britain as composed of outposts of several floras — from France, the Pyrenean region, Scandinavia, and other parts. Watson also distinguishes Agrarian and Arctic zones of distribution in Great Britain, each with three subdivisions marked by characteristic vegetation. The number of Phanerogams has been computed at 1,600 species, and there are probably at least twice as many Cryptogams. Among the very rare flowering plants, *Oxytropis campestris, Lychnis alpina, Astragalus alpinus, Saxifraga cernua, Eriocaulon septangulare* may be noted.

Transportation.— The prosperity of the country has been greatly furthered by all parts of the United Kingdom having been brought into easy communication with each other by means of roads, rivers, canals, and especially railways. On all of these sums of almost fabulous amount have been expended, and in the case of railways especially, nothing is more remarkable than the number of these which now traverse the United Kingdom in all directions; and which, particularly in the greater part of England and in central Scotland, cover the whole face of the country, and intersect one another at innumerable points. From 1825 to 1850, a period of a quarter of a century from the opening of the first railway, 6,621 miles of railway were constructed in the United Kingdom, being an average of 265 miles in each year. Between 1850 and 1860, 3,812 additional miles were constructed, giving an average of 381 miles in each year; and between the latter year and the end of 1881, 7,747 miles were constructed, being at the rate of 369 miles every year. The total mileage then amounted to 18,175, which by 1891 had increased to 20,191 miles. On 1 Jan. 1901, there were in all 21,855 miles of railway open in the United Kingdom, of which 15,187 miles belonged to England and Wales, 3,485 to Scotland, and 3,183 miles to Ireland. Of the total paid-up capital of £1,176,001,890, England and Wales absorbed £970,147,581, Scotland, £166,088,736, Ireland, £39,765,573. The net receipts of the railways of the three kingdoms were £89,392,501, £11,603,010, £3,806,347, respectively; total, £104,-801,858. When compared with other European countries, the United Kingdom is seen to stand fourth in point of the actual length of railways open, the first being Germany, the second and third France and Russia. When the number of miles of railway in proportion to the area of

the United Kingdom is compared with those of other countries, it occupies the position of second in order, for whereas the United Kingdom has only 17.4 miles of railway to every 100 square miles of surface, Belgium has 31.4 miles of railway to 100 square miles of surface. Belgium's total length of railways, however, is only 3,590 miles. The total length of tramways in the United Kingdom is fully 1,000 miles. The canals have a total length of over 3,800 miles.

Among the means of communication, in a somewhat different sense of the word, may also be mentioned the postal, including the telegraph, system of the United Kingdom. In the year 1901 2,323,600,000 letters were delivered in the United Kingdom, giving an average of about 57 per head of population. Of post-cards 419,000,000 and of book-packets, circulars, and newspapers 981,200,000 were delivered.

Since the transfer of the telegraphs to the state in 1870, the telegraph system has been greatly increased by additional lines and offices, and the business has increased in a still greater proportion. In 1901 the total length of telegraph wires in the United Kingdom was over 347,680 miles with 46,295 miles of line. The number of messages sent in the year was over 89,000,000. Of these some 75,000,000 were forwarded from offices in England and Wales, and over 9,280,000 from offices in Scotland. This department has also telephone exchanges in various towns, beside 60 miles of pneumatic tubing in London.

Agriculture. — Thorough and systematic draining, the extensive use of artificial manures, and the employment of the newest implements are among the chief features of modern British agriculture. A peculiar feature of English as distinguished from Scotch husbandry is the large amount of arable land in England forming permanent hayfields. These are kept fertile by heavy doses of farmyard manure. Although much of the land employed is naturally of poor quality, it produces a close sward of the richest green, furnishing admirable food for stock. The great extent of permanent pasture is also a feature of Irish agriculture. In the rearing and fattening of stock there is no country in the world that can be compared to several districts of Great Britain. Among breeds of horses, the race-horse, the "shire horse," the Suffolk punch, and the Clydesdale may be mentioned; among cattle, the shorthorn, the Hereford, the Aberdeen-Angus, and the Ayrshire; among sheep, the South Downs, Leicesters, Cheviots, and black-faces. The principal cereals grown in England are wheat, barley, and oats, occupying about equal areas; the principal green crops are turnips, potatoes, mangolds, vetches, etc. In Ireland and Scotland oats are the principal grain crop; the chief green crop being in Ireland potatoes, in Scotland turnips. Hops are grown largely in Kent, less extensively in some other parts of southern England. Of the whole area of Great Britain less than 60 per cent is under the plow or in pasture, but in England the proportion is about 75 per cent, and in Wales above 60 per cent, while in Scotland it is under 25 per cent (so much of Scotland being barren). In Ireland the proportion is about 75 per cent. Agriculture is there in a different condition from that of Great Britain, being in a very backward state on the whole, mainly owing to the subdivision of holdings and over-cropping, combined with ignorance and unskilfulness.

The following table gives a general idea of the distribution of crops in the United Kingdom:

Crops	England and Wales	Scotland	Ireland
	Acres	Acres	Acres
Under corn crops	6,128,911	1,271,424	1,105,026
Under green crops ...	2,513,878	619,592	1,390,941
Grasses under rotation, clover, etc.........	3,303,366	1,607,984	1,252,889
In permanent pasture	15,178,178	1,381,214	11,390,950
Fallow land...........	344,815	7,279	16,857

The total in crops, bare fallow, or grass thus amounted altogether to nearly 48,000,000 acres. The mountain and heath land furnishing pasture and not included in these figures is: For England, 2,249,164 acres; Wales, 1,187,404 acres; Scotland, 9,420,370 acres. The total number of agricultural holdings in Great Britain above one acre is about 520,000, in Ireland it is about 514,000.

The following table shows the number of horses used in or connected with agriculture, and of cattle, sheep, and pigs in the United Kingdom in 1901:

Animals	England and Wales	Scotland	Ireland
Horses	1,315,579	201,581	513,788
Cattle	5,376,089	1,246,284	4,486,242
Sheep	19,155,246	7,587,948	4,287,274
Pigs	2,317,479	134,116	1,253,682

In British farming a period of severe depression has prevailed since about 1875. For many years previous to this agriculture had been in the most flourishing condition, prices being high and large profits being made. Since then the reverse of this has been the case. Prices of almost all kinds of farm produce have fallen enormously, large numbers of farmers have been ruined, and others even at greatly reduced rents can scarcely make headway; while a good deal of land has gone out of cultivation. The main cause of this is the severe competition of foreign countries and British colonies, combined with bad seasons. In 1874 the average prices of wheat, barley, and oats were respectively, $13.38, $10.78 and $6.92. The average price of wheat per quarter in 1894 was only $5.48 — the lowest recorded for 124 years. The average price of barley was $5.88, the lowest since 1850, while the price of oats was $4.10. Recently there has been some improvement in prices of grain. The prices of beef, mutton, dairy produce, and wool have also undergone a great reduction during the period referred to. The result of the changed conditions has been that, while in 1871-5 the land under the plow in England and Wales annually averaged 13,696,000 acres, and that under pasture 10,217,000 acres, the figures for 1901 were as given above; the increase in pasture showing that farmers, on the whole, find it pays better to feed stock than to raise grain.

Minerals.—Such is the mineral wealth of the British Isles that, with the exception of quicksilver and gold, which, though found both in Great Britain and Ireland, are so limited in quantity as hardly to repay the labor for searching for them, it is scarcely possible to mention

a metal or mineral product of economical value which is not worked to a greater or less extent. Coal claims precedence, not merely because the annual output of it in regard both to quantity and aggregate value exceeds that of any other mineral product, but because without it the other natural resources of the country and the industry of its inhabitants must have forever remained in a great measure undeveloped. The coal fields are not confined to one particular district, but occupy a series of basins sometimes touching, but more frequently at a considerable distance from each other, and extending in an irregular curve from the Ochil hills to the Bristol Channel. Beginning with the farthest north limit, we find a coal field occupying a not inconsiderable part of Fifeshire and almost the whole of Clackmannanshire. The coal of this field is of several kinds; but the most important seams are splint, part of it of a free, open, burning quality, greatly in demand for steam navigation from its not corroding the furnaces and boilers, and part of it admirably adapted for the blast furnace. Part of this field, immediately to the west of Dunfermline, contains a coal which in its richness and quality of caking, bears a resemblance to that of Newcastle, and has been worked, as ancient records prove, for at least five centuries. On the opposite side of the Forth, and almost in visible communication with the field already described, another field extends over part of eastern Stirlingshire and a considerable portion of the Lothians. It furnishes the greater part of the fine fuel which is used in the metropolis of Scotland, and contains excellent seams of parrot coal. To the south are the coal basins of Lanark, Renfrew, and Ayrshire; the first much the largest, and famous throughout the world for the immense industrial establishments which it mainly has called into existence and made prosperous. On passing the border the Newcastle coal field lies before us, extending over a great part of the counties of Northumberland and Durham, and centring near Newcastle, which gives it its name. The proximity of this field to the sea, and the excellence of the coal, unrivaled for domestic use, early made it the great theatre of mining operations. The association of coals with Newcastle has long been proverbial. It is Durham, however, that now yields most of the coals, a larger quantity being mined here than in any other English county. This field furnishes a large proportion of the coal conveyed by sea both to home and foreign ports. The next coal field to the south is in many respects the most important of all. It includes a large central space, not entirely occupied by coal, but interrupted longitudinally by a broad belt which consists of the lower strata of the carboniferous system, and thus forming a kind of twin fields, the one of which extends from Leeds to Nottingham, while the other borders both on Manchester and Liverpool. This great coal area can boast, not only of being the seat of what has been termed the world's great workshop, but of furnishing the most essential elements both of its existence and prosperity. The only other coal field of a magnitude similar to those already mentioned is that of South Wales, which, though it long lay almost unknown or unheeded, has in comparatively recent times become the centre of great and varied industries, while Cardiff, as its maritime outlet, has risen to be a large town and the greatest coal-exporting seaport in the world. There are several other minor fields, all of them, with exception of that of North Wales, situated near the centre of England, and thus, from position as much as from extent, possessed of great value. Their names are: the North Staffordshire, the Shropshire, the South Gloucester and Somersetshire, the Warwickshire, and the South Staffordshire. The most important on the list are the North Staffordshire, the principal seat of the potteries, and the last two, Warwickshire and South Staffordshire. In South Staffordshire occurs the enormous seam known as the Ten-yard Coal of Dudley. It properly consists of several seams separated by very thin beds of clay. The output of coal in Great Britain, which in 1855 was only 61,453,079 tons, has been on the increase ever since. About a sixth part of the total produce is now usually exported to foreign countries or British possessions, and about the same consumed in the manufacture of iron. The following table shows the recent progress of the coal trade:

Years	Mined	Exported	Retained
1879	133,808,000	16,442,296	117,365,704
1889	176,916,724	28,956,445	147,960,279
1894	188,277,525	31,756,368	156,521,157
1898	202,054,516	36,562,796	165,491,720
1900	225,181,300	46,098,228	179,083,072

The value of the coal mined in 1900 was £121,652,596.

The iron ores smelted in Great Britain are principally carbonates, which are invariably found to a greater or less extent and in a great variety of forms, with very different qualities, in the coal measures. Yet more than two fifths of the ores now smelted are oxides (principally hematite and hydrated oxide). The most important iron districts yielding carbonates are those of Yorkshire, especially the rich Cleveland district in the North Riding, Shropshire, Staffordshire, South Wales, and the coal measures of Scotland. Hematite (red) is obtained chiefly in Lancashire and Cumberland; brown hematite to a smaller extent in South Wales and Cornwall. Hydrated oxide or brown iron ore is found principally in the counties of Northampton and Lincoln. Hematite is by far the richest of these ores, and hydrated oxide comes next in this respect. The following table shows the quantity and value of the pig-iron produced in the United Kingdom in some recent years:

Years	Quantities	Value
1879 ....Tons	5,995,337	£14,788,342
1889 .... "	8,322,824	20,390,918
1894 .... "	7,427,342	17,082,887
1900 .... "	8,959,691	....

Lead, tin, and zinc are the metals produced next in importance to iron. The value of the lead produced in the United Kingdom in 1900 was £349,094; of the tin, £523,604; of zinc, £97,606. Small quantities of copper and silver are obtained. An important article is salt, chiefly from rock-salt and brine pits, the quantity produced in 1900 being valued at £620,898. Salt is most extensively worked in Cheshire, and the supply is so great as to be inexhaustible. Quarries exist in almost every part of the British Isles. They furnish admirable building stone of various kinds, including in some localities

granite, which is employed for ornamental and other purposes. Limestone is plentiful, as are also clays of various kinds; and from Wales and other parts are obtained quantities of the finest roofing slates. The total value of coal and metals mined in 1900 was £135,957,676.

Fisheries.—The fisheries of the United Kingdom have long been of importance, and latterly their importance has considerably increased, larger vessels being now employed, and many of them propelled by steam. One great obstacle to the general consumption of fresh fish, namely, the difficulty to transport, is now much diminished by the facilities offered by the railways; and in some important inland towns, where fresh fish were previously known only as an expensive luxury, they can now be had at a price which places them within the general reach. The principal fresh-water fisheries are those of salmon, carried on chiefly in the rivers and estuaries of Scotland and Ireland. The chief sea-fisheries are those of herrings, haddocks, cod, and the various kinds of flat fish — plaice, soles, turbot, etc. The herring fishery is carried on on almost all the coasts and islands of Scotland, but especially on the east coast, the great centres of resort for curing being the towns of Wick, Peterhead, Fraserburgh, Aberdeen, etc. Many herrings are also caught on the east coast of England. The other fishes mentioned are caught all around the coasts, and especially in certain localities in the North Sea, one of the most famous being in the neighborhood of the Dogger Bank. Among minor fisheries may be mentioned those of mackerel, pilchards, oysters, and lobsters. The value of sea-fish caught in 1901 was £9,044,502; including shell-fish, £9,492,379.

Manufactures.—The manufactures of England began to establish themselves at a period long before those of Scotland came into existence. Tin is said to have been the first article of British commerce. The Phœnicians are generally said to have visited the coasts of England for the purpose of procuring tin.

Though of modern origin, cotton is the most important of British manufactures. The chief seat of the manufacture is in Lancashire, where Manchester and a number of other large towns, such as Oldham, Bolton, and Preston, are more or less supported, directly or indirectly, by this industry. The cotton manufacture of Scotland is on a comparatively limited scale, and is even of less importance than formerly. It chiefly centres in Glasgow and the surrounding district. Cotton thread is made extensively at Paisley. The importance of the cotton manufacture will be understood from the fact that it gives employment to about 529,000 persons, while the cotton goods exported (not to speak of those consumed in the country) form the largest individual export among the numerous exports sent by Great Britain to foreign countries. During the three years 1889–91 the annual export of cotton goods had an average value of fully £72,000,000; since that time it has somewhat decreased, the annual value in 1896–98 being a little over £66,000,000. The raw cotton imported has in recent years had a value of from £30,000,000 to more than £46,000,000 annually. The latter figure represents the value for 1891, while a larger quantity in 1898 was valued at only £34,000,000. The quantity imported which in 1820 only amounted to 152,000,000 pounds, amounted in 1901 to 1,830,305,904 pounds. Though the manufacture of woolen cannot boast of an extension like that of cotton, it holds the next place to it among textiles; and, besides working up the greater part of the wool grown within the kingdom, draws largely on other countries for additional supplies, particularly on the Australian colonies. In some branches the British manufacturers have formidable competitors on the Continent, but in others the position of the United Kingdom is at least as high as that of any other country, while in not a few the superiority is decided. The chief centres of the woolen manufacture are in England — the West Riding of Yorkshire (Leeds, Huddersfield, etc.), Lancashire, Gloucestershire, and Wiltshire being the most distinguished for broadcloths; Bradford and Norfolk for worsted stuffs; Leicestershire and Nottinghamshire for woolen hosiery. Blankets and flannels have numerous localities, but for the finer qualities the west of England and several of the Welsh countries are most conspicuous. Carpets of every quality and pattern are extensively made at Kidderminster, Halifax, Worcester, etc.; and Wilton and Axminster have given their names to famous fabrics of this kind. A modern branch of the woolen manufacture is that of shoddy. Its raw material consists of woolen rags, which, being reduced to the state of wool, are then remanufactured. The principal seat of the shoddy trade is the Leeds district.

The woolen manufacture of Ireland is yet on a rather limited scale, but seems to be making some progress. Among the goods made are blankets and flannels, friezes, tweeds, and serges — Irish wool being chiefly used. Scotland has made much more progress, but still bears no proportion to England. The chief seats of the Scotch woolens are Kilmarnock for carpets, bonnets, etc.; Glasgow for carpets, etc.; Stirling and its neighborhood for carpets and tartans; Galashiels, Hawick, Selkirk, and other places in the basin of the Tweed for shawls, plaids, etc., and still more for the kind of cloth known as "tweeds," the manufacture of which originated here, and which are also made at Dumfries and Aberdeen; Hawick for hosiery; Alloa for yarn. The woolen manufacture in all its branches gives employment to about 282,000 persons, while the value of the woolen and worsted manufactures (including yarn) exported from Great Britain has in recent years varied from more than £25,000,000 per annum to less than £20,000,000.

In England the spinning of flax into yarn and the weaving of the yarn into cloth is an old industry, and is carried on to a great extent, but is apparently not increasing. The chief seat of the manufacture is the West Riding of Yorkshire, the chief towns engaged in the industry being Leeds and Barnsley. Linen is the great staple of Ireland, where it is carried on chiefly in the province of Ulster (counties of Antrim, Down, Tyrone, etc.); and in Scotland also it was long the staple among textile fabrics. In the former, extraordinary means were employed to foster it. It early fixed its seat near Belfast, which continues to be its great centre.

The forms given to the manufactured flax in Ireland include not only plain linens, but also many of the finer varieties — lawn, cambric, damask, etc. In Scotland the manufacture also assumes great variety, embracing coarse goods such as osnaburgs, sheetings, sailcloth,

sacking, etc. — chief seat, Dundee; and diaper and damask — chief seat, Dunfermline. The staples of both towns are by far the most important of their kind in the kingdom; and the Dunfermline table-linens are not surpassed anywhere. Large quantities of jute goods have been manufactured for a considerable number of years, especially at Dundee. The value of the linen and jute manufactures (including yarn) exported in 1902 was £9,784,141.

In the case of silk, as in that of cotton, the raw material is entirely of foreign production. The chief source of supply is China, from which is obtained more than three fourths of the raw silk consumed in the United Kingdom; and after China the next countries in order of importance in this regard are France, Japan, and British India. The silk manufacture, however, can hardly be regarded as a very important British industry. The silk mills are confined chiefly to England, the chief seats being London, Manchester, Macclesfield, and Coventry. The silk manufactures exported are of trifling value compared with those imported.

The manufacture of machinery of all kinds is an extremely important branch of the industry of the United Kingdom, embracing steam engines, textile machinery, agricultural machinery, sewing machines, and various other descriptions. In 1902 steam engines of various kinds were exported to the value of £4,520,000; and the total exports of machinery were valued at £18,751,812. Here should also be mentioned plate and sheet iron, tin-plates, rails and railway materials, wire, bars, hoops, tubes, etc.; as well as guns and war materials, tools and implements of various kinds, telegraphic and electric apparatus. For minuter articles of hardware reference may be made to the countless products such as Sheffield and Birmingham produce, not excluding articles in the precious metals — plate, jewelry, and watches, made extensively in various places, but nowhere in the wide world so perfectly as in London. The exports of hardware and cutlery in 1902 amounted to £2,177,549; of steel and iron and other manufactures thereof to £24,641,516.

Very extensive are the manufactures of clothing, haberdashery, and millinery, and of vehicles, furniture, cabinet and upholstery wares. So also are the industries connected with earths, both in the more ordinary forms of pottery and in that of porcelain, with its classic shapes and gorgeous colors and exquisite designs, the Wedgwood being among the most widely known of such wares. The largest quantity of non-translucent earthenware is manufactured in Staffordshire. Among earths, at least as to principal constituents, we may include glass in its various forms, the principal of which are window glass and bottles.

Another notable manufacture is that of paper in all its different varieties. In connection with it are various industries, of which it may be considered as, directly or indirectly, the parent — type-founding, printing, books, newspapers, and with them literature in its various departments, engraving, etc. Besides the various classes of paper and stationery exported there is of course an immense consumption at home. Among other important miscellaneous manufactures are those of chemicals, manures, leather and leather goods (boots and shoes, saddlery), india-rubber goods, floorcloths, etc. Here may also be mentioned preserved provisions in great variety, confectionery, spirits, and ales.

The chief seats of British ship-building are Glasgow and other Clyde ports, Newcastle and other Tyne ports, Sunderland, Hartlepool, Belfast, Stockton, Middlesborough, London, and Barrow-in-Furness. The output for 1900 was 665 sailing vessels, with a net tonnage of 41,839; 705 steam vessels, with a net tonnage of 654,158 (1,079,583 tons gross); or in all, 1,370 vessels, with a total net tonnage of 695,997. Besides these there were built for foreigners 196 sailing and steam vessels, having a total net tonnage of 207,452 tons; the steamers numbering 165, with a net tonnage of 171,560 and a gross tonnage of 278,955.

Commerce.— Of the extent of the commerce carried on by railway, river, canal, and highway there are no means of forming a just estimate, though it must be of enormous extent. The foreign trade, or commerce properly so called, is more easily calculated, at least in all its leading branches. The following table will show the progress it has made, and the extent it has attained:

EXPORTS.

Years	Imports	British Produce	Foreign & Colonial Produce	Total Exports
	£	£	£	£
1856....	172,544,154	115,826,948	23,393,405	139,220,353
1873....	371,287,372	255,164,603	55,830,162	310,994,765
1880....	411,229,565	223,060,446	63,354,020	286,414,466
1883....	426,891,579	239,799,473	65,637,597	305,437,070
1892....	423,892,178	227,060,224	64,400,420	291,460,644
1897....	451,238,683	234,350,003	59,833,677	294,183,680
1901....	522,238,986	280,498,889	67,846,843	870,584,718

In 1856 the imports per head of the population amounted £6, 3*s*, 2*d*; the exports of British produce, to £4, 2*s*, 10*d*. In 1901 the amounts were respectively £12, 11*s*, and £6, 14*s*, 10*d*.

The chief articles and values of the imports and exports in 1901 were:

IMPORTS.

Animals, living (for food)	£ 9,400,033
(a) Articles of food and drink duty free.	162,949,666
(b) Articles of food and drink dutiable.	47,595,501
Tobacco, dutiable	4,819,473
Metals	30,787,452
Chemicals, dyestuffs, and tanning substances	6,129,559
Oils	11,030,606
Raw materials for textile manufactures..	70,401,772
Raw materials for sundry industries and manufactures	57,954,510
Manufactured articles	93,609,754
(a) Miscellaneous articles	17,298,198
(b) Parcel post	1,262,462
Total	£522,238,986

EXPORTS.

British produce.	
Animals, living	£ 742,499
Articles of food and drink	14,884,915
Raw materials	33,977,644
Articles manufactured and partly manufactured, namely:	
(a) Yarns and textile fabrics	103,471,561
(b) Metals and articles manufactured therefrom (except machinery)	39,413,762
(c) Machinery and mill work	17,855,335
(d) Ships, new (not registered as British)	9,159,876
(e) Apparel and articles of personal use.	10,940,060
(f) Chemicals, and chemical and medicinal preparations	8,942,109
(g) All other articles, either manufactured or partly manufactured	38,068,759
(h) Parcel post	3,642,369
Total British produce	£280,498,889
Foreign and colonial produce	67,846,843
Total	£348,345,73[illegible]

The registered sailing vessels engaged in the home trade of the United Kingdom were in 1900, 6,203; their tonnage 378,957; their crews numbered 23,734. The steam vessels in the home trade were 3,545, with a tonnage of 508,359, and crews numbering 40,288 men. The vessels engaged partly in the home, partly in the foreign trade, numbered 401, their tonnage 217,478, and their crews 5,649. The sailing vessels in the foreign trade were in 1900, 1,143, of 1,594,838 tons, and 25,856 men; steam vessels 3,648, burden 6,695,575 tons, crews 151,921. The total number of vessels employed in the trade of the United Kingdom was thus 14,935, with an aggregate burden of 9,395,207 tons, and crews numbering in all 247,448. The total number of vessels registered as belonging to the kingdom was 19,982 of 9,304,108 tons.

Export Statistics.—A comparison of figures of domestic exports of the leading nations of the world, bring out some interesting facts:

DOMESTIC EXPORTS, 1870.

United Kingdom	$971,000,000
Germany (1872)	552,000,000
France	511,000,000
United States	377,000,000
India	255,000,000
Russia	216,000,000
Austria-Hungary	192,000,000
Netherlands	154,000,000
Italy	146,000,000
Belgium	133,000,000

DOMESTIC EXPORTS, 1890.

United Kingdom	$1,282,000,000
United States	845,000,000
Germany	792,000,000
France	724,000,000

DOMESTIC EXPORTS, 1902.

United Kingdom	$1,379,000,000
United States	1,392,087,672
Germany	1,113,000,000
France	818,000,000
Netherlands (1901)	696,000,000
India	408,000,000
Austria-Hungary	388,000,000
Belgium	358,000,000
Russia (1901)	369,000,000
Italy	284,000,000
Brazil (1901)	197,000,000
Switzerland	169,000,000
Argentine	173,000,000
Spain	142,000,000
China	135,000,000
Japan	127,000,000
Sweden (1901)	95,000,000
Chile (1901)	63,000,000
Norway	46,000,000
Mexico	42,000,000

Bibliography.— Acworth, 'Railways of England' (1900); Anderson, 'Book of British Topography' (1891); Bagehot, 'Lombard Street — the Money Market' (1893); Brassey, 'The British Navy' (1883); Buxton, 'Finance and Politics' (1888); Canning, 'British Rule and Modern Politics' (1898); Dilke, 'Imperial Defence' (1892); 'Problems of Greater Britain' (1890); Egerton, 'British Colonial Policy' (1897); Garnier, 'Annals of British Peasantry' (1895); Geike, 'The Rivers of Great Britain' (1897); Green, 'History of the English People' (1880); Hull, 'Physical History of the British Isles' (1882); Johnstone, 'Mineral Geology' (1897); Lecky, 'History of England' (1890); Mackinder, 'Britain and British Seas' (1891); May, 'Constitutional History' (1871); Nicholson, 'National History of Great Britain' (1886); Pollock, 'History of English Law' (1895); Root, 'Studies in British Finance' (1901); Stoughton, 'Religion in England' (1881); Stubbs, 'Constitutional History' (1897); Turnbull, 'Index of British Plants' (1890); Turner, 'The Bank of England' (1897); Webb, 'History of Trade Unionism' (1894); Wekins, 'War and Policy' (1900); Williams, 'The Growth of the British Navy' (1898); Whitaker, 'Almanac' (annually).

Great-crested Flycatcher, a large flycatcher (*Myiarchus crinitus*), which is a summer visitor to all parts of temperate North America, and is noted for its shrill, yet musical scream, and for its habit of entwining one or more cast-off snake-skins in its large tree-lodged nest. It is olive-brown above, with an ashy head surmounted by a tall brownish crest, and the lower parts delicate yellow. Several other species belong to the southwestern States and Mexico, and are often called crested kingbirds.

Great Dane, a breed of large, smooth-coated dogs, the modern equivalent of the ancient boar-hound. See DOG.

Great Divide, The. See DIVIDE, THE GREAT.

Great Eastern, a British iron steamship, before the Celtic the largest vessel constructed, built (1854–8) at Milwall, on the Thames, for the Eastern Steam Navigation Company, by Scott Russell, from plans by I. K. Brunel; length 680 feet; breadth, 82½, or, including paddle-boxes, 118 feet; height, 58 feet (70 to top of bulwarks). She had 6 masts, 5 of iron and 1 of wood, and could spread 7,000 yards of sail, besides having 8 engines, divided between her screws and paddles, and capable of working at 11,000 horse-power. From the first her career was unfortunate, the launching process alone lasting three months and costing $300,000. After several unremunerative trips to New York she was employed first as a troop-ship, and then as a cable-laying ship, for which her size and steadiness specially qualified her. Various attempts were afterward made to utilize her, but she at last came to be a mere holiday spectacle, and was broken up in 1888.

Great Expectations, a novel by Charles Dickens, published in 1861. As in 'David Copperfield,' the hero tells his own story from boyhood. Owing to the simplicity of the plot, and to the small number of characters, it possesses great unity of design. These characters, each drawn with marvelous distinctness of outline, are subordinated throughout to the central personage "Pip," whose great expectations form the pivot of the narrative.

Great Falls, Mont., city, county-seat of Cascade County; on the Missouri River, the Great Northern, and the G. F. & C. Railways; 120 miles northeast of Butte. South and nearby is a great mining region and north is an agricultural and grazing section. It has large gold, silver, and copper smelters, and bituminous coal, lead, iron, and sandstone are found in the vicinity. The excellent water power which the city possesses is an inducement to manufacturers to establish works in Great Falls. There are a number of falls here; one, Great Falls, gives name to the city. The first settlement was made in 1884, and in 1888 Great Falls was incorporated. Its rapid growth has been largely the result of its natural resources. Its chief manufactures are flour, furniture, mining and agricultural instruments, wagons, carriages, and woolen goods. The population increased from (1890), 3,979 to (1900) 14,930.

Great Horned Owl. See EAGLE OWL.

Great Island. (1) A small island at the entrance to Portsmouth Harbor, N. H. It has a lighthouse 90 feet high. (2) An island in Bass Strait, between Tasmania and Australia. It is about 40 miles long and 12 miles broad. Pop. 42,100.

Great Kanawha, ka-nâ'wa, a tributary of the Ohio River, has its rise between the Blue Ridge and Iron Mountains in the northwestern part of North Carolina, flows northeast by north through the southwestern part of Virginia, then changes its course northwest and west into West Virginia, and flows into the Ohio River at Point Pleasant. It receives the Gauley River in Fayette County, West Virginia, and from thence to its mouth is known by the name of Great Kanawha. The river, at a cost of over $4,000,000, has been made navigable from th Ohio to Great Kanawha Falls, about three miles from the mouth of the Gauley River. It is about 450 miles in length.

Great Kanawha, Battle of. See POINT PLEASANT.

Great Lakes, the name given to the chain of lakes on the northern border of the United States. They include Lakes Superior, Michigan, Huron, Saint Clair, Erie, and Ontario; Michigan only lying wholly within the United States, and no one of the lakes wholly within the territory of the Dominion of Canada. Their area is about 90,000 square miles; elevation, Lake Superior 600 feet above the sea, and Lake Ontario 250 feet. The fall of Lake Superior to Lake Erie is about 40 feet. No large river flows into the Great Lakes; the Saint Lawrence River is the outlet. The basin of the Great Lakes averages in width about 100 miles north and south of the north and south shores respectively. The combined coast lines in the United States have a shore line of about 3,075 miles. These great inland seas constitute the largest body of fresh water in the world. Like all large bodies of water they affect the climate of the surrounding country. Good farms, extensive forests, and valuable minerals are found along the coast. On the southern shore of Lake Superior (q.v.) are found masses of ore and low mountains apparently of eruptive origin. The Great Lakes have been the means of developing to a considerable extent the Northwest, as they are the main thoroughfares by which the products of the large farms, the cattle ranches, the mines, and the forests have been brought to eastern markets. Coal and manufactured products of the east pass over the lakes to western markets. The bituminous coal tonnage of the lakes for 1899 was 9,000,000 tons. In the same year the net freight tonnage of Sault Ste. Marie's Falls canal was over 25,000,000 tons, or three times the amount which passed through the Suez Canal. The iron ore tonnage for 1900 was 20,000,000 tons. There are 20 individual ports on the Great Lakes which have a registered tonnage ranging from 1,000,000 to over 5,000,000 tons. Cleveland's tonnage alone, in 1902, was 5,037,282 tons; and the same year New York's tonnage was 8,982,767 tons. The line of cities around the Great Lakes are (1903) increasing in commercial importance and population with more rapidity than any group of cities in any other part of the world. Some of those lake ports, all terminals of railroad trunk lines, are Toledo, which increased 61 per cent from 1890 to 1900; Chicago, which increased in the same time 54 per cent; Cleveland, 46 per cent; Milwaukee, 39 per cent; and Buffalo, 37 per cent. The question of locating a dam at the outlet of Lake Erie so as to benefit navigation has been under consideration, and efforts are being made (1903) to have commissioners appointed by the governments of the United States and Great Britain who will work together, and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada. In June 1903, the Congress of the United States took action regarding the matter, and empowered the President to appoint three American Commissioners; one to be an engineer officer of the army; another, a civil engineer, «well versed in the hydraulics of the Great Lakes;» the third, a lawyer «of experience in questions of international and riparian law.» The necessity of such a commission to examine even the variations in the levels of the waters of this great thoroughfare is manifest when the levels of Detroit River, Lake Saint Clair, Saint Clair River, and Saint Mary's River have been lowered by the Government twenty-one-foot channels from Duluth and Chicago to Buffalo. The Chicago Drainage Canal (see Chicago) has helped to lower Lake Michigan. The Consolidated Lake Superior Company is taking water out of Saint Marys River. Other causes are making a change of level, and the increased transportation on all the lakes, will mean better channels to the ocean. For canals connecting the Great Lakes with rivers and the two around water-falls, see articles on the respective lakes.

Great Meadows, Pa., Engagement at, 28 May 1754; Washington's first fight. When the French built Fort Duquesne (now Pittsburg), driving off an English force which had begun to fortify the same spot, it was evident that the decisive struggle for mastery of the American «hinterland» was to begin; and the commander of the nearest English force, a Virginia militia officer of 22, named George Washington, at once sent a messenger to Gov. Dinwiddie and wrote letters to the governors of Pennsylvania and Maryland, urging all to send troops and expel the French. Meantime he set out with his force to build a fort on the Monongahela where Brownsville, Pa., now stands. Constructing a road as he went, he halted at the Great Meadows of the Youghiogheny, a bushy field at the foot of Laurel Hill,— a good camping-place and defensible position. Hearing from his scouts that the French had learned of the English activity, and sent out a party to engage any English band they met, he cleared the field of bushes and threw up an intrenchment behind a ravine crossing the field; but instead of waiting an attack, took 40 men for a night surprise of the French, guided by Indian allies. It was raining hard, the path was often lost, and he did not reach the French camp till morning. They were an advance party of 32, sent out to reconnoitre and, hearing of Washington's advance, they had hidden in a rocky hollow and sent back for reinforcements, but attempting defense when surprised, the commandant — Ensign Jumonville — and nine men were killed, and the rest captured and taken to the camp at Great Meadows. Washington lost one killed and three wounded. The sequel is told under FORT NECESSITY.

Great Pacificator, a name given Henry Clay (q.v.), on account of his efforts to reconcile the conflicting interests of North and South, especially in connection with the Missouri Compromise.

Great Pedee, a river which has its rise in the mountains of the northwestern part of North Carolina, flows south and east across the State, and enters South Carolina at Marlboro County, in the northeastern part of the State, then flows southeast into Winyaw Bay, an inlet of the Atlantic. In North Carolina the river is called Yadkin. About where the Little Pedee joins the Great Pedee, and south to its mouth, there are several quite large islands. The river is navigable for a distance of about 150 miles from Winyaw Bay.

Great Salt Lake, a body of water in the northwestern part of Utah, the principal drainage centre of the Great Basin (q.v.); bounded on the east by the Wasatch Mountains, on the west by the Great Salt Lake Desert. It is about 4,200 feet above sea-level, 80 miles long and from 20 to 32 miles wide. Its chief inlets are the Bear, Ogden, and Weber, and the Jordan which brings the fresh waters of Lake Utah. Great Salt Lake has no apparent outlet save evaporation. In 1850 the amount of saline matter held in solution was 22.4 per cent, in 1869 only 14.8 per cent. Between these dates the amount of water flowing in annually exceeded the evaporation, and the lake increased in area from 1,700 to 2,360 square miles. Since 1869–70 the lake has been receding. One cause of the water diminishing in volume is the amount used for irrigation; but the amount of water contributed by the inlets has decreased since 1870. At one time Great Salt Lake was much larger than it is now. The bars, cliffs, and beaches formed by the waters of the ancient lake (called Lake Bonneville) are plainly visible along the base of the mountains. Lake Bonneville had an area of 19,800 square miles and a depth of 1,100 feet. Its depth near where the great Mormon Temple now is was about 850 feet. Its dry bed is now occupied by nearly 200,000 people. The waters of Lake Bonneville reached the ocean through Columbia River. Geological investigations show that there have been at least two moist periods with intervening and subsequent periods of dryness. A change from the present dry climate and scant rainfall to a moist climate would result in a great increase in area of the waters in the lakes and rivers and a return to former water areas. Great Salt Lake has several islands, the largest of which Antelope, is 18 miles long. No fishes seem to exist, but several species of insects and brine-shrimps have been found in the waters; and water-fowls in large numbers frequent the shore. The first mention of Great Salt Lake appeared in a report made by the Franciscans, in 1776. Father Escalante and companions seem to have traveled from Mexico to this region. A report made also by the Franciscans early in the 17th century mentions the large rivers and lakes and the mineral wealth of this section. In 1843 Fremont explored and described this region, and a thorough survey was made in 1849–59 by Howard Stansbury, captain in the United States Army. (See UTAH.) Consult: 'Jesuit Relations'; Bancroft, 'Utah'; U. S. Reports and Surveys.

Great Slave Lake, a body of water in the Canadian Northwest Territory, lat. 62° N.; greatest length about 300 miles, greatest breadth 50 miles. Estimated area, 10,100 square miles. By the Great Slave River it receives the waters of Lake Athabasca; and the outlet is the Mackenzie River which flows into the Arctic Ocean.

Great Slave River, in Canada, is the outlet of Athabasca Lake and flows into Great Slave Lake (q.v.), by two mouths, near Fort Resolution. A number of falls and rapids are in its upper course, but the descent becomes more gradual near its mouth. Length about 300 miles.

Great South Bay, an arm of the Atlantic Ocean on the southern coast of Suffolk County, Long Island, N. Y.; 50 miles long, from one and one-half to five miles wide. Great South Beach, which is about 35 miles long, has Fire Island lighthouse on the western extremity, and separates the bay from the ocean.

Great Stone Face, one of Hawthorne's short stories relating to the "Old Man of the Mountain" in the White Mountains, in 'Snow Image and Other Twice Told Tales' (1852).

Greatorex, grāt'ō-rĕks, **Eliza Pratt,** American artist: b. Manor Hamilton, Ireland, 25 Dec. 1819; d. Paris, 9 Feb. 1897. She studied art in New York and Paris. Her work began in landscape painting, but pen and ink work and etching subsequently absorbed her efforts. In 1868 she was elected associate of the National Academy. In 1870 she visited Germany and in 1871 published 'The Homes of Oberammergau.' Her principal works are 'Summer Etchings in Colorado' (1873) and 'Old New York from the Battery to Bloomingdale' (1876).

Grebes, grēbz, a well-defined group of water-bird (*Colymbidæ* or *Podicipidæ*) comprising 25 species, spread over practically the whole world. The grebes are peculiar in having the legs placed very far back, in their flattened tarsi and lobed (not webbed) toes, each digit being flattened and bordered by an extension of horny skin. They are expert swimmers and pre-eminent as divers. They nest in secluded ponds and bogs, piling up a mass of vegetable matter upon some floating foundation, and deposit chalky white eggs. When the female leaves the nest she usually covers the eggs over with vegetable matter. The little grebes are expert swimmers and divers from the time they are hatched, and in their soft downy plumage are exceedingly beautiful. During migrations grebes are found frequently along our rivers and sea coasts, and are often shot by duck hunters in the autumn and winter. Though they have no stiffened tail feathers, and have relatively very small wings, they are able to fly long distances. The body plumage is soft and compact, and that of the under surface is a beautiful silvery white, which makes "grebe-breasts" a very desirable article in the millinery trade. The best-known species in eastern North America are the horned grebe (*Colymbus auritus*) which has a peculiar ruff of black and rusty feathers about the head; and the pied-billed grebe (*Podilymbus podiceps*) a rather more heavily built bird without a ruff and with a thicker and shorter bill. Both are popularly known as "hell-divers." In Europe the common species are the horned grebe, the great crested grebe (*C. cristatus*) and the dabchick (*C. fluviatilis*).

Greece, Ancient, the European peninsula which was bounded on the north by Macedonia and Illyria; on the east and southeast by the Ægean and Myrtoan, and in the west, and southwest, by the Ionian seas. Its length from the borders of Macedonia to Cape Tænarum was about 262 miles. The name of *Græcia* originated in Italy, and was probably derived from Pelasgian colonists, who, coming from Epirus to Magna Græcia, in southern Italy, and calling themselves *Græci,* occasioned the application of this name to all the people who spoke the same language with them. In earlier times, for example, in the time of Homer, Greece had no general name among the natives. Aristotle was the first Greek to call his countrymen **Γραικοί**, Greeks. It afterward received the name of *Hellas,* and still later, after the country was conquered by the Romans, it was divided into two provinces: the Peloponnesus being known as Achaia, and the remaining regions to the north as Macedonia. The Grecian tribes were so widely dispersed that it is difficult to determine with precision the limits of Greece, properly so called. The name perhaps is properly applied only to the country lying to the south of Macedonia, with the adjacent islands; but it has sometimes been given in a modern sense by geographers to the whole territory lying to the south of Mount Hæmus, Mount Scomius, and the Illyrian Alps, or the whole series of mountains now called the Balkan, so as to include regions inhabited by some Thracian, Macedonian, and Illyrian tribes. The area of the mainland of the more limited region to which the name of Hellas is properly confined is above 55,000 square miles. The whole of Greece naturally divides itself into three parts: Northern Greece, including Epirus and Thessaly; Central Greece, which comprises what was known as Hellas; and the Peloponnesus.

Physical Features.— The first thing which strikes the eye on looking at a map of Greece is the comparatively great extent of its coastline, formed by numerous gulfs which penetrate into it in all directions, and give it a remarkably broken and rugged appearance. Proceeding round the coast from the northwest to the northeast we are presented in succession with the Ambracian Gulf (now Gulf of Arta), Corinthian Gulf (the mouth of which is now called the Gulf of Patras, while the name of Gulf of Corinth is reserved for the inner part of it), the Cyparissian (now Arcadian) Gulf, and the Messenian, Laconian, Argolic, Saronic, Maliac, and Pagasæan gulfs, now called respectively Koron, Marathon, Nauplia, Athens, Lamia, and Volo. The Corinthian Gulf on the east, and the Saronic Gulf on the west, which nearly meet at the Isthmus of Corinth, divide Greece into a continental and a peninsular portion, the latter called the Peloponnesus (now Morea). Another striking feature is the mountainous character of the interior. The whole country was bounded on the north by a range of mountains, the western half of which was called Mount Lingon and the eastern half the Cambunian Mountains, with Mount Olympus at their eastern extremity. From about the middle of this range a lofty chain, called Mount Pindus, strikes southward and runs almost parallel to the eastern and western coasts of Greece. At a point in this chain called Mount Tymphrestus or Typhrestus (now Mount Velukhi), two chains proceed in an easterly direction, the northernmost of which, Mount Othrys, runs almost due east, and attains at some points a height of from 7,000 to 8,000 feet, while the southern one runs rather in a southeasterly direction, attaining at one point a height of 8,240 feet, and terminates at the celebrated pass of Thermopylæ. The Cambunian Mountains on the north, the range of Pindus on the west, and Othrys on the south, enclose the large and fertile vale of Thessaly, forming the basin of the Peneus (now Salambria), and the ranges of Othrys and Oeta enclose the smaller basin of the Sperchius (Hellada). Another range of mountains branches off from Mount Œta and runs still more to the south. This is the celebrated Parnassus, which, at its highest point, exceeds 3,000 feet. The peaks of Cithæron, Parnes, Pentelicus, and Hymettus lie in the same direction, but are more distinguished for their classic celebrity than for their height. The range in which these peaks are found is continued to the southeast point of continental Greece, and the islands of Ceos, Cythnos, Seriphos, and Siphnos (now Kea, Thermia, Serpho, and Siphanto) may be regarded as continuations of it. This range on the south and that of Œta on the north enclose the basin of the Cephissus, with Lake Copais (now Topolia). Another chain of mountains strikes southwestward from the central range of continental Greece, under the names of Corax and Taphiassus. The chief rivers on the west side of the Pindus chain are the Arachthus (now Arta) and the Achelous (now Aspropotamo).

The chief feature in the mountain system of the Peloponnesus is a range or series of ranges forming a circle round the valley of Arcadia in the interior, having a number of branches proceeding outward from it in different directions, dividing the rest of the Peloponnesus into several other valleys. The loftiest part of the mountainous circle round Arcadia is that lying to the north, with the peak of Cyllene (Ziria), 7,789 feet high, at its eastern extremity, and Erymanthus (Olonos), 7,297 feet high, at its western. The southern part consists rather of a series of heights than a chain of mountains. The highest range which branches off from the circle around Arcadia, and, indeed, the highest range in the Peloponnesus, is Mount Taygetus (Pentedactylon), which strikes southward, separating the ancient divisions of Messenia and Laconia, and terminating in the promontory of Tænarum (now Cape Matapan). The other chains are of no importance. The only rivers in the Peloponnesus of any consequence are the Eurotas (Iri), draining Laconia on the southeast; the Pamisus (Pirnatza), draining Messenia on the southwest; the Alpheus (Ruphia), draining Arcadia and Elis; and the Peneus (Gastuni) draining Elis on the west.

The rock most largely developed in the mountains of Greece is limestone, which often assumes the form of the finest marble. Granite and gneiss are found only in the north, in the eastern ramifications of the Pindus. Tertiary formations prevail in the northeast of the Peloponnesus; and in the northwest, along the shores of Elis, are considerable tracts of alluvium. Volcanic rocks are not seen on the


GREECE
AND PART OF
TURKEY.
IN EUROPE.
SCALE OF MILES
Population of places is indicated by different lettering, thus
ATHENS
Patras
Corfu
Railroads
ADRIATIC SEA
ITALY
GULF OF TARANTO
IONIAN SEA
TURKEY
GREECE
MOREA
MEDITERRANEAN SEA
SEA OF CANDIA
CRETE OR CANDIA
BLACK SEA
SEA OF MARMARA
ASIA MINOR
ADRIANOPLE
CONSTANTINOPLE
SALONIKI
ATHENS
Piraeus
Patras
Corfu
Cephalonia
Santa Maura
Mitylene or Lesbos
Scio or Chios
SMYRNA
MANISSA
BRUSA
Aidin
Samos
Rhodes
Karpathos
Canea
Candia
Athos
NORTHERN SPORADES
Hermopolis
Mt. Lycabettus
ACROPOLIS
STADIUM
ATHENS and Vicinity
Longitude
East
from
Greenwich

1. Parthenon, on the Acropolis, Athens.
2. Temple of Victory, on the Acropolis, Athens.

mainland, but form considerable masses in some of the islands. Attica was rich in silver and marble. The quarries of Pentelicus and the mines of Laureium were famous. Gold and serpentine were found in Siphnos; there was tin in Ceos, and copper near Chalcis in Eubœa. In many of the islands iron abounded.

Divisions.— On the northwest of the mainland of Greece was the mountainous region of Epirus, which was never more than half Greek; and to the east of that district, separated from it by the chain of Pindus, lay Thessaly, a region of fertile plains. To the south, lay a series of small independent states. Reckoned from west to east, there were Acarnania, Ætolia, Doris and Locris, Phocis with Mount Parnassus, the seat of the Muses, and the sacred Delphi, regarded by the Greeks as the navel of the earth; Bœotia, with Helicon, another mountain sacred to the Muses, and with the cities of Thebes and Platæa; Megaris, containing the city of Megara; and Attica with its capital Athens, Piræus, the port of Athens, and the city of Eleusis, the seat of the mysterious worship of Demeter. In the middle of the Peloponnesus was Arcadia, with the towns of Mantinea, Tegea, and Megalopolis, the last founded by Epaminondas. In the north lay Sicyon and Corinth, the latter situated on the isthmus connecting the Peloponnesus with the rest of Greece; and to the west of that Achaia. To the southwest of Achaia lay the rich province of Elis, with the plain and sacred grove of Olympia, celebrated on account of the Olympic games, which were held here every fourth year. To the south of Elis, in the southwest corner of the Peloponnesus, lay the province of Messenia, with the famous stronghold of Ithome, "one of the horns of the Peloponnesus," the fort of Pylos, and later the capital town of Messene, founded by Epaminondas 369. Separated from Messenia by the range of Taygetus was the province of Laconia, occupying the southeast corner of the Peloponnesus, and containing the renowned city of Sparta, long the rival and ultimately the conqueror of Athens. Lastly, to the north of Laconia, the east of Arcadia, and the south of Sicyon, lay the province of Argolis, with the capital Argos, and the cities of Mycenæ and Tiryns, all remarkable for the remains of gigantic works of masonry, commonly known as Cyclopean works.

The islands of Greece are partly scattered over the Ægean Sea and partly contained in the Ionian Sea on the southwest of the mainland. The Greeks applied the names Cyclades and Sporades to two groups of islands in the Ægean, the former name (from *kuklos*, a circle) to those which they believed to form a circle round the sacred island of Delos, and the latter (from a Greek root meaning scattered, sporadic) to those which were scattered over various parts of the sea. Some islands were sometimes said to be in the one group and sometimes in the other, and several were sometimes excluded from both. The following, however, are the principal of those which may most properly be considered as belonging to the Cyclades: Andros, Tenos, Myconos, Naxos (now Naxia), Paros (celebrated for its marble), Amorgos, Anaphe, Thera (now Santorin), Pholegandros (now Polykandro), Sicinos, Ios (now Nio), Melos, Syros, and Gyaros (Jura), Siphnos, Seriphos, Cythnos, and Ceos. The name Sporades may be applied to all the other islands in the Ægean. The Sporades will thus include the following islands on the northeast of the mainland of Greece: Eubœa (Negropont), the largest of all the Greek islands, separated from the continent only by the narrow strait of Euripus, and containing the ports of Chalcis and Eretria; Sciathos, Scopelos, Halonesus (Kilidromi), Eudemia (Sarakino), and Scyros; the following off the coasts of Thrace and Asia Minor: Lemnos, Thasos, Imbros, and Samothrace (in very remote times the seats of a mysterious religious worship) Lesbos (with the flourishing and luxurious town of Mitylene), Chios, Samos, Cos, etc.; and the following in the Saronic Gulf, or between it and the Argolic Gulf: Salamis (now Salamis or Koluri), Ægina, Calauria (Poros), Hydrea (Hydra), and Pityussa (Spetsæ). The islands in the Ionian Sea are Corcyra (Corfu), celebrated in the most ancient times for its wealth and culture, and at a later period colonized by Corinthians; Paxos, Leucas or Leucadia (Santa Maura), at one time connected with the mainland; the "rocky" Ithaca (now vulgarly called Ithaki), the home of Ulysses; Cephallenia (Cephalonia), Zacynthus (Zante), and Cythera (Cerigo), one of the seats of the worship of the goddess Aphrodite.

Soil, Productions, Etc.— Greece was in ancient times more fertile than it is now, which is accounted for by the fact that the forests have been to a large extent cleared away, the springs thus dried up, and the soil deprived of moisture. The most fertile districts were Thessaly, Bœotia, and some parts of the Peloponnesus; the least fertile Attica and Arcadia. The principal objects of cultivation were the vine and the olive, but flax and the commoner cereals were also cultivated more or less. Among the domestic animals were horses, asses, mules, oxen, swine, sheep, goats, and dogs. Swine were very numerous everywhere, and mules were much used in the Peloponnesus; but there were comparatively few horses, as the mountainous character of the country was not conducive to their being reared; the best horses of Greece were reared in Thessaly. Bears, boars, and wolves are mentioned among the wild animals anciently found in Greece, and it may perhaps be inferred from the legend of the Nemean lion that even lions at one time existed in this country. Herodotus, indeed, expressly states that lions were found between the Nestus in Thrace and the Achelous in Acarnania.

Climate.— The climate of ancient Greece is highly commended by ancient Greek writers, as by Herodotus, Hippocrates, and Aristotle, on which account it seems fair to infer that the malaria which now infests the air in summer did not then prevail to the same extent, a circumstance that is easily accounted for by the fact that in those times the country was more thickly populated and better cultivated. In respect of temperature the same differences resulting from the inequalities of the surface must have existed then as exist now, long and severe winters being experienced in the highlands of the interior, while the lowlands, exposed to the sea, enjoyed warm and genial weather all the year round.

History.— Greece has never at any period formed a single and independent state. As long as it remained independent it was divided into a number of separate states, and during

the only period when it was administered as a single territory it was subject to a foreign power. A general sketch of the history of ancient Greece must therefore touch only upon those leading events which belong to the common history of the Greek states, or which at least affected the Greek people as a whole, even although they may belong more especially to the history of an individual state.

The earliest inhabitants of Greece of whom anything is known are called by Greek writers Pelasgians. The ethnological affinities of these have often been discussed, but the most recent authorities believe that they were an Indo-Germanic or Aryan people. They occupied Greece before the influx of Ionians, Æolians and Dorians. They seem to have been agricultural in pursuits, dwelt along the fertile valleys, built strong cities, walls of the so-called cyclopean masonry, and among their most famous seats were Dodona in Epirus, Thessaly, Orchomenos in Bœotia, Mycenæ in Argolis, Sicyon, etc.

In religion they abhorred both polytheism and anthropomorphism. Their name afterward became changed to Hellenes and under this appellation they amalgamated with the Ionians, the Achæans, the Æolians and the Dorians. The early relations of Greece with the East are perhaps reflected in the legends of Oriental colonists — Cadmus, Pelops, Cecrops, etc. — who settled in Greece in very remote times. The reality of an early connection between Greece and the East is established by the fact that the Greeks derived the greater part of their alphabet from the Phœnicians.

The Hellenes, or Greeks properly so called, entering the country probably from the northwest, subdued and partly displaced the Pelasgians. They are usually represented as having been divided into four chief tribes — the Æolians, occupying the northern parts of Greece (Thessaly, Bœotia, etc.); the Dorians, occupying originally only the small region in the neighborhood of Mount Œta; the Achæans, occupying the greater part of the Peloponnesus; and the Ionians, occupying the northern strip of the Peloponnesus and Attica. The middle part of the Peloponnesus was still mainly inhabited by a Pelasgic population. The warlike and enterprising character of these Hellenic invaders is evidenced by the poetic legends of their achievements in the heroic ages, such as the tale of the Trojan War, of Theseus, of Jason and the Argonauts, etc. From all these we may gather at least that the Hellenes early distinguished themselves by building towns, making long voyages, planting distant settlements, and carrying on foreign wars. As in later times, they were divided into numerous states, each consisting of a single city with the surrounding territory. These states were governed by kings who were the heads of the supreme families, and who traced their descent from Zeus. By the side of the kings stood the heads of the other leading families of the state, who in Homer are also called kings, and likewise boasted of a descent from Zeus. In the public market-place (agora), where all the affairs of the state were transacted, these subordinate kings gave their opinions on every subject of deliberation, and advised the supreme ruler as to the course he should pursue, but beyond that they had no authority. Their influence, however, was very great, especially where the rightful head of the state did not possess the abilities of a ruler.

The distribution of the Hellenic tribes which we have just indicated is not that which continued throughout the main period of Greek history. It was entirely altered by an event called the Dorian migration, or sometimes the return of the Heracleids, which is placed by Thucydides about 80 years after the fall of Troy, and thus about the year 1104 B.C., according to the ordinary system of chronology. Before the great migration several smaller ones had taken place. One tribe, finding its territory too circumscribed, would move to another, expelling the inhabitants already settled there, who thus found themselves compelled to remove to some other district, where they treated the original inhabitants in the same way that they had been treated themselves. In this way there arose a general disturbance, till at last the hardy Dorian inhabitants of the mountainous region about Mount Œta began a migration on a greater scale than had hitherto been attempted, and thus brought about a series of changes which resulted in an entirely new settlement of the Greek territory. They first conquered a large part of northern Greece, and then entered and subdued the greater part of the Peloponnesus, driving out or subjugating the Achæans, as the Achæans had driven out or subjugated the Pelasgians. The Dorians are also said to have invaded Attica, where, however, they were baffled, according to the legend, by the self-devotion of Codrus, the king of that territory. It is said that an oracle had pronounced that in this war whichever side lost its king would be victorious, on which account strict orders were given to the Dorian soldiers to spare the life of the king of the enemy. But Codrus disguised himself in the dress of a common herdsman, and going into the enemy's camp provoked a quarrel in which he met his death, on learning which the Dorians despaired of success and withdrew. In the legend in which this series of events has come down to us the Dorians are represented as having entered the Peloponnesus under Temenus, Cresphontes, and Aristodemus, three descendants of Heracles, who had come to recover the territory of which their ancestors had been unjustly deprived by Eurystheus. Hence the name of the Return of the Heracleids, sometimes given to this event.

The Achæan inhabitants of the Peloponnesus whom the Dorians found there had a threefold fate. One part of them sought for new homes, and turned their steps toward the part of the Peloponnesus occupied by the Ionians, whom they expelled, keeping for themselves their territory, which hence received the name of Achaia. Another part voluntarily submitted to the invaders, who imposed tribute upon them and excluded them from all share in the government; while a third part resisted to the last, and were in the end reduced to the condition of slavery. In Laconia the former received the name Periœci (dwellers round), and the latter were called Helots.

The Ionians who were driven out of the Peloponnesus found at first a refuge among their kindred in Attica, but when this district did not suffice for all the inhabitants, old and new, large numbers of them left it and founded

Ionic colonies on several of the islands of the Ægean Sea and on the middle part of the coast of Asia Minor, where they built 12 cities, which formed an Ionic Confederacy. The principal of these were Ephesus and Miletus. About the same time as the Ionians are said to have colonized the middle part of the seaboard of Asia Minor, another body of Greeks, proceeding from Thessaly and Bœotia, are said to have founded the Æolian colonies on some of the northern islands of the Ægean, and on the northern part of the western coast of Asia Minor. The Æolic colonies of Asia Minor also formed a confederacy of 12 cities, but the number was afterward reduced to 11 by the accession of Smyrna to the Ionic Confederacy. While Ionians and Æolians thus colonized the middle and northern islands of the Ægean and coasts of Asia, the southern islands and the southern part of the west coast of Asia Minor were in like manner colonized by Dorian settlers. The six Doric towns in Asia Minor, along with the island of Rhodes, formed a confederacy similar to the Ionic and Æolic ones.

In considering the subject of Greek colonization we are brought face to face with the fact that in settling in foreign lands, the Greek races kept distinct from each other. One of the great keys to an understanding of Greek history is a right understanding of the relation between the two great races of the Greek name, the Dorians and Ionians. The Dorians were inland mountaineers, the Ionians were of the seacoast. The former, as represented in the institutions of Sparta, were a practical, and conservative race, living in public, simple and unimaginative. Their poetry was the public ode, accompanied with the dance in the market-place, often carried on under arms. The Ionians were versatile, imaginative, impressible. They were devoted to the maritime life, were travelers, and fond of welcoming strangers to their cities. They were traders. Moreover, they were keenly intellectual and reached the summit of excellence in art, literature, and philosophy. Their poetry was the epic narrative; and they invented the drama, in which the Ionian tale of personal adventure was united with the Doric ode. These two contrasted races between them swayed the fate of Greece. Their relations were complicated by the different colonies which they established at different points on the Mediterranean and Euxine coasts. In the course of time new Greek settlements were made on the coasts of the Hellespont, the Propontis (Sea of Marmora), and the Black Sea by both Dorians and Ionians. The most important of these were Byzantium (Constantinople) (Dorian), Sinope (Ionian), Cerasus (Ionian), and Trapezus (Trebizonde) (Ionian). Further, there were flourishing Greek colonies on the coasts of Thrace and Macedonia: for example, Abdera, Amphipolis, Olynthus, Potidæa, etc., which were all Ionian; and the Greek colonies in Lower Italy were so numerous that the inhabitants of the interior spoke Greek, and the whole region received the name of Greater Greece. The most famous of the Greek colonies in this quarter were Tarentum, Sybaris, Croton, Cumæ, and Naples. The island of Sicily also came to a great extent into the hands of the Greeks, who founded on it or enlarged many towns. By far the largest, most powerful, and most highly cultured of the Greek colonies was the Dorian colony of Syracuse, founded in the 8th century B.C. On the north coast of Africa the Dorian colony of Cyrene rivaled in wealth and commerce the city of Carthage; and on the south coast of Gaul Ionian Massilia (Marseilles) presented a model of civilized government to the inhabitants of the surrounding districts. All these towns kept up a commerce in the products of the land in which they were planted. They exerted a most important and beneficent influence on the manners of the neighboring inhabitants. They preserved the customs and institutions of their mother city, which they regarded with filial reverence; but otherwise they were perfectly free and independent.

Although ancient Greece never formed a single state, the various Greek tribes always looked upon themselves as one people, and classed all other nations under the general name of *Barbaroi* (foreigners). There were four chief bonds of union between the Greek tribes. First and chiefly they had a common language, which, though it had considerable dialectic peculiarities when spoken by different tribes, was yet understood throughout every part of Greece and in all the Greek colonies. Secondly, they had common religious ideas and institutions, and especially in the oracle of Delphi (q.v.) they had a common religious sanctuary, which was held by all the states in equal reverence, and was resorted to from all parts of Greece, alike by communities and individuals, for advice in circumstances of difficulty, and not unfrequently for indications as to the future. Thirdly, there was a general assembly of the Greeks called the Amphictyonic League (q.v.) in which the whole nation was represented by tribes (not by states), and the chief functions of which were to guard the interests of the sanctuary of Delphi, and to see that the wars between the separate states of Greece were not carried on in too merciless a manner. When any of the ordinances of the league were violated it was its duty to see that the violators were punished, and to entrust the infliction of the punishment to some one of its members. The fourth bond of union between the tribes of Greece consisted in the four great national festivals or games, the Olympian, Isthmian, Nemean, and Pythian (qq.v.) which were held at different intervals in four different parts of Greece, in which all Greeks, and none but Greeks, were allowed to participate, and which slaves were not allowed even to witness. At these games contests took place in foot-racing and chariot-racing, boxing, wrestling, and throwing with the quoit (or discus), and prizes were also awarded for works of art, poems, dramas, histories, etc. The prize was a simple wreath of olive or pine branches, or of parsley; but such a prize brought glory not only on the winner himself, but on his whole family and kindred, and even on the state to which he belonged. The victor was welcomed home by a triumphal procession, and his victory was celebrated in odes sung on the occasion, and sometimes composed by such poets as Simonides and Pindar. The Olympic games were the most celebrated of these festivals. They were held in the summer once every four years at Olympia, in Elis; the month in which they were held was considered as sacred, and during it no acts of hostility were allowed to take place between

any of the Greek states. Originally, the only contest was a foot-race, and so high was the honor of a victory in this race esteemed, that from that of Corœbus in 776 B.C. the whole of Greece reckoned the time. The year in which any event happened was styled the first, second, third, or fourth year of a certain Olympiad, the name given to the interval elapsing between each celebration.

The various small states of Greece may be divided, according to the form of their constitution, into the two great classes of aristocratic and democratic. Sparta or Lacedæmon, the chief town of Laconia and of the Dorians, was the leading aristocratic state; and Athens, the capital of Attica and the chief town of the Ionians, was the leading democratic state; and as a rule all the Doric states, and subsequently all those under the influence of Sparta, resembled that city in their constitution; and all the Ionic states, and those under the influence of Athens, resembled it. These two races are the only ones that come into prominence during the earlier part of Greek history subsequent to the Doric migration. Sparta is said to have derived its form of government, and all its institutions, near the close of the 9th **century** B.C., from Lycurgus, who made minute regulations as to the course of education and the mode of life among the Spartans. He had but one object, that of training the Spartan youth for war, and developing a hardy and warlike spirit among the people. The immediate results of this training were seen in the conquests which the Spartans effected over the surrounding states, especially over the Messenians in the 8th and 7th centuries B.C. Many of the vanquished Messenians left their native country and founded the city of Messana in Sicily. Those who remained were reduced to the condition of Helots (q.v.).

The constitution of Athens was not originally democratical, but monarchical. Afterward it became aristocratic, and first received a more or less democratic constitution from Solon at the beginning of the 6th century B.C. This was followed about 50 years later by a despotic monarchy under the celebrated "tyrant" Pisistratus, and his sons, Hippias and Hipparchus, the last survivor of whom, Hippias, reigned in Athens till 510 B.C. Hipparchus had been assassinated four years before; and the last four years of the reign of Hippias were distinguished by violence and cruelty. His enemies drove him from Athens, after which the republic was restored in a more purely democratic form than at first.

Hippias found refuge at the court of the king of Persia, with whose aid he hoped to be able to return and rule once more in Athens. The Persian monarchy had been established about 30 or 40 years before by Cyrus the Great, and its sway extended not only over the whole of Persia, Media, and Babylonia, but also over Egypt and Asia Minor. With the rest of this last-mentioned territory the Greek colonies on the coast had been brought under the yoke of this empire, and although they chafed under the foreign dominion, they were kept in subjection by the native princes or tyrants whom the Persian monarch imposed on them as governors. One of the most powerful of these governors was Histiæus of Miletus, whose behavior had excited the distrust of Darius, the Persian king, for the latter, on the pretence of rewarding him for a signal service invited him to his court and kept him at Susa in practical captivity. Histiæus secretly incited his relative, Aristagoras of Miletus, to get up a rising among the Greek colonies of Asia Minor, in the hope that he might, during the disturbance, find an opportunity of returning to his home. The endeavors of Aristagoras were successful; all the Greek towns on the coast were soon in arms, and assistance was asked from the mother country. Only Athens, which feared lest Darius should re-establish Histiæus, and the small Ionian town of Eretria in Eubœa, furnished any aid. The Greeks, in 496 B.C., conquered and burned the town of Sardis, the capital of Asia Minor, whereupon the rebellion extended over the whole of Ionia. But the superior forces of the enemy, and the want of union among the insurgents, led in the following year (495) to the loss of a naval battle, and soon after to the destruction of Miletus, the inhabitants of which were partly put to death and partly made captives.

Darius now determined to avenge himself on the Athenians and Eretrians for the part that they had taken in the rising. In 492 he sent out an expedition against them under his son-in-law Mardonius, but the Persian fleet was wrecked off the promontory of Mount Athos. Darius had at the same time despatched heralds to the islands and states of Greece to demand earth and water in token of submission. Most of the islands and many of the smaller states yielded, but Athens and Sparta indignantly refused the demand, and even went the length of putting the heralds to death. Enraged at this insult Darius equipped a second fleet and placed it under the command of Datis and Artaphernes. But this met with no better fate than the first. The Persians landed on the island of Eubœa, and after destroying Eretria, crossed the Euripus into Attica; but here they were met (490 B.C.) on the plain of Marathon by 10,000 Athenians and 1,000 Platæans, under Miltiades, and, although 10 times as numerous, were totally defeated and pursued to their ships. This battle put an end to the second Persian expedition, but Darius at once began to make preparations for a third expedition, and this time on a far greater scale than before. In the midst of these preparations he died, but his son Xerxes, collected an army of 1,700,000 men and a fleet of 1,200 large ships besides a number of smaller ones, crossed the Hellespont in 481 by means of two bridges of boats, and led his army through Thrace, Macedonia, and Thessaly, while his fleet followed the line of coast. Thessaly had surrendered without a stroke, and Xerxes at once pursued his march in the direction of Phocis. But before he could enter this territory he had to make his way through the narrow and difficult pass of Thermopylæ, and this had previously been occupied by 300 Spartans under Leonidas, along with several thousand allies. Here Xerxes in vain attempted to force a passage against a mere handful of Greeks; thousands of his troops were slain; and it was only after Ephialtes had betrayed to the Persians a foot-path which led over the heights of Œta to the rear of the defenders of the pass, that the Persian king effected his purpose. Leonidas allowed all the allies to depart, while he himself and his 300 Spartans,

along with 700 Thespians who voluntarily remained with them, held out until they were completely annihilated (480 B.C.).

The way through Phocis and Bœotia was now open to the Persians, who advanced into Attica, and laid the city of Athens in ruins, putting to death the small garrison. The women and children belonging to Athens had by this time, on the advice of Themistocles, been removed to Salamis, Ægina, and Trœzen, while all the men capable of bearing arms served in the fleet. It was to Themistocles that the deliverance of Greece was now chiefly due. The united fleet of the Greeks had already contended with success against that of the Persians off the promontory of Artemisium, in Eubœa, and had then sailed into the Saronic Gulf, whither it was followed by the enemy. In this confined arm of the sea, where there was no room for the manœuvring of the numerous ships of the enemy, a decisive battle between the two fleets took place with the result that Themistocles had anticipated, the total defeat of the Persians. This battle is known as the battle of Salamis, from the name of an island in the Saronic Gulf, and was fought in the same year as Thermopylæ (480 B.C.). Xerxes himself had been an eyewitness of the battle and at once began a speedy retreat with his land army through Thessaly, Macedonia, and Thrace, a retreat which Themistocles had hastened by causing the false report to reach Xerxes, that it was the intention of the Greeks to destroy the bridges of boats over the Hellespont. Xerxes left behind him only 300,000 men in Thessaly. In the spring of the following year (479) these advanced into Attica and compelled the citizens once more to seek refuge in Salamis; but in the battle of Platæa the Greeks, under the command of Pausanias, obtained so complete a victory, that only 40,000 of the Persians reached the Hellespont. On the same day the remnant of the Persian fleet was attacked and defeated by the Greeks off Mount Mycale, near Samos on the Ionian coast of Asia.

By the brilliant part which the Athenians under Themistocles had played against the Persians, the influence of Athens had greatly increased throughout Greece; and this was further strengthened by the fact that the war aginst Persia, which still continued, was chiefly conducted by sea, where Athens was much more powerful than Sparta. From this date then begins the period of the leadership or *hegemony* of Athens in Greece, which continued to the close of the Peloponnesian war, 404 B.C. Athens now exerted her influence to form a confederacy including the Greek islands and maritime towns as well as Athens herself, the object of which was to provide for the continuance of the war by the payment into a common treasury at Delos, of a fixed sum of money, and by furnishing ships for the same purpose. In this confederacy Athens of course had the lead, and gradually was able to render tributary many of the islands and smaller maritime states. In 469 B.C. the victories won by the Athenians over the Persians was crowned by the double victory of Cimon, the son of Miltiades, over the fleet and army of the Persians on the river Eurymedon, in the south of Asia Minor; and this victory was followed by the Peace of Cimon, which secured the freedom and independence of all Greek towns and islands. Shortly after followed the brilliant administration of Pericles, during which Athens reached the height of her political grandeur, while at the same time she flourished in trade, in arts, in science, and in literature.

The position of Athens, however, soon raised up a number of enemies. Sparta regarded her prosperity with jealousy; and the arrogance of Athens had produced a pretty general feeling of indignation and hatred. Two hostile confederacies were formed in Greece. At the head of one of these confederacies was the city of Athens, which was joined by all the Ionian states of Greece, and more or less supported by the democratic party in every state. At the head of the other confederacy stood Sparta, which was similarly joined by all the Dorian states, and supported by the aristocratic party everywhere. At last in 431 war was declared by Sparta on the complaint of Corinth that Athens had furnished assistance to the island of Corcyra in its war against the mother city; and on that of Megara, that the Megarean ships and merchandise were excluded from all the ports and markets of Attica.

In the first part of the Peloponnesian war the Spartans had considerable successes, while a great calamity befell the Athenians, who had collected all the inhabitants of the country districts of Attica within the walls of the city; and in consequence a pestilence broke out which carried off thousands of the inhabitants, and among them Pericles himself. From this blow, however, the city soon recovered, and in 425 the early successes of the Spartans in Attica were compensated by the capture of Pylos in Messenia by the Athenian general Demosthenes, who at the same time succeeded in shutting up 400 Spartans in the small island of Sphacteria, opposite Pylos, where they were ultimately starved into surrender. The person to whom the surrender was made was the demagogue Cleon, who, in consequence of his military successes, obtained the command of an army which was sent to operate against the Spartan general Brasidas in Thrace. But in 422 he was defeated by Brasidas before the town of Amphipolis, and himself slain, after which the opposite party in Athens got the upper hand, and concluded the peace with Sparta known as the Peace of Nicias (421 B.C.).

The effect of this peace was to divide the Spartans and the Corinthians, who had hitherto been allies. The latter united themselves with Argos, Elis and some of the Arcadian towns to wrest from Sparta the hegemony of the Peloponnesus. In this design they were supported by Alcibiades, a nephew of Pericles, a man of handsome figure and great personal accomplishments. The war which was now waged between Sparta and Corinth with her allies resulted, however, in favor of the former, whose arms were victorious at the battle of Mantinea in 418.

Soon after this the Athenians resumed hostilities, fitting out in 415 B.C. a magnificent army and fleet, under the command of Alcibiades, Nicias, and Lamachus, for the reduction of the Dorian city of Syracuse in Sicily. This undertaking, which renewed the race hatred between Sparta and Athens, was a complete failure. Alcibiades was accused in his absence of several offenses against religion and the constitution, and deprived of his command. Thirsting for revenge, he betook himself to Sparta, and ex-

horted the city to renew the war with Athens. By his advice one Spartan army was despatched to Attica, where it took up such a position as prevented the Athenians from obtaining supplies from Eubœa, while another was sent under Gylippus to assist their kindred in Sicily. These steps were ruinous to Athens. Lamachus fell in the siege of Syracuse, and the Athenian fleet was totally destroyed. The reinforcements sent out under Nicias and Demosthenes were defeated (413 B.C.) by the combined Spartan and Syracusan armies. All the Athenians who escaped death were made captives and compelled to work as slaves in the quarries of Sicily, although it may be mentioned as an interesting fact that many of these captives obtained their liberty by being able to recite fragments of Euripides.

After this disaster many of the allies of Athens joined the Spartans, who now pressed on the war with greater energy. The Athenians recalled Alcibiades, who returned in 407, and was received by his fellow-citizens with enthusiasm as their expected deliverer. A few months later he was again an exile, having been deprived of the command because one of his subordinates had lost a naval battle fought off Ephesus in his absence. During the rest of the war the Athenians had only one success, the naval victory won off the islands of Arginusæ over the Spartan Callicratidas in 406. In the following year (405) the Spartans made themselves masters of the whole of the Athenian fleet except nine vessels, while the majority of the crews were on shore at Ægospotamos on the Hellespont. The Spartans now easily subdued the islands and states that still maintained their allegiance to the Athenians, and laid siege to Athens itself. In 404 B.C. the war was terminated by the Athenians' surrender. Sparta immediately imposed upon Athens an aristocratic form of government, placing the supreme power in the hands of the Thirty Tyrants. Only a year later, however (403), Thrasybulus was able to overthrow this hated rule and re-establish the democracy.

The fall of Athens resulted in Sparta's leadership or hegemony in Greece, which lasted till the battle of Leuctra, 371 B.C. The Spartans now abused their power and speedily roused the hatred and jealousy of the other states. The Greek states which had up to this time been, and still continued to be, leaders, had now lost almost entirely their manliness and independent spirit, and no longer maintained the hereditary war against Persia, but each sought the aid of that power for its own purpose. The Spartans did indeed send an expedition into Asia Minor, but it came to nothing; and the states of Greece, the Spartans included, at last, in 387, agreed to the disgraceful Peace of Antalcidas, by which the whole of the west coast of Asia Minor was ceded to the Persians, and the Greek colonies there thus deprived of the independence that had been secured to them by the Peace of Cimon.

An act of violence committed by a Spartan general in Thebes in 380 in the end led to the complete downfall of that city. The aristocratic party in Thebes, when the Spartan army happened to be in the neighborhood, prevailed upon the general to give his assistance in overthrowing their opponents and establishing an aristocratic government. A number of the less prominent members of the defeated party, among them Pelopidas, made their escape to Athens, where they got the support and assistance of the democratic party there. They soon returned in disguise to their own city, surprised and murdered the leaders of the aristocratic party, expelled the Spartan garrison, and again set up a democratic government. These circumstances give a good idea of the fury of party strife which was then general in the Greek cities. The immediate result of this counter-revolution in Thebes was a war with Sparta, the heroes of which were Epaminondas and Pelopidas, who were then at the head of affairs in Thebes. In the course of the war the Spartans invaded Bœotia, but were so completely defeated at Leuctra in 371 B.C. that they never fully recovered from the blow.

With this victory Thebes won hegemony in Greece, which she maintained during the lifetime of Epaminondas, whose policy it was to keep down the power of Sparta by strengthening the surrounding states. From him the Messenians recovered their freedom, and by his advice the cities of Arcadia formed themselves into a confederacy, and built the city of Megalopolis. This policy was at first successful, but in a few years the confederacy began itself to strive after the supremacy, and joined themselves with this object to the Spartans. Epaminondas then invaded the Peloponnesus, but although the Thebans totally defeated the Spartans and Arcadians in the battle of Mantinea (362), yet the victory being won with the loss of their great general, the Thebans could no longer boast with justice of supremacy in Greece. Pelopidas had died two years before.

Two years after the death of Epaminondas, Philip, the father of Alexander the Great, became king of Macedonia. He was a man of great ability as a soldier and a ruler, an admirer of the Greek character, and a lover of Greek art and literature. He perceived, however, the weakness of the Greeks, arising from their want of unity, and waited for an opportunity of interfering in the affairs of their country, with the view of ultimately making himself master of it. An occasion for interference was furnished him by the Sacred war (355–46). The Phocians having taken possession of some of the land belonging to the sanctuary of Delphi, the Amphictyonic League condemned them to pay a fine and restore the land they had taken. This was refused and the league imposed upon the Thebans the task of forcing the Phocians to submit, but in their rocky strongholds the Phocians were able to resist all the efforts of their assailants, who at last called in the aid of Philip of Macedon. With his help the Phocians were subdued, they themselves expelled from the league, and their place given to Philip.

It was not, however, till the Locrian war (339–8) that Philip acquired a firm hold in Greece. The Locrians had committed the same offense as that of the Phocians, and when they likewise refused to pay the fine imposed upon them by the league, Philip, as one of the members, received the charge of punishing them. The advance of Philip was at first witnessed with comparative indifference by the states of Greece, but when his real designs became apparent the Athenians, on the advice of Demosthenes, hastily concluded an alliance with the Thebans, and an army was sent out to oppose

him. The battle of Chæronea (338) turned out, however, disastrously for the Greeks, who saw their whole country laid at the feet of Philip. But the conqueror treated his new subjects with mildness, wishing to reconcile them to the Macedonian yoke, and to win their co-operation in his projected invasion of the rotten empire of Persia. He collected a large army, of which he got himself declared commander-in-chief by the Amphictyonic League in an assembly held at Corinth in 337 B.C.; before he was able to start he was assassinated 336 B.C.

The design of Philip on Persia was taken up and carried out by his son Alexander the Great, during whose absence Antipater was left behind as governor of Macedonia and Greece. Soon after the departure of Alexander, Agis III. of Sparta headed a rising against Antipater. He was defeated, however, in the battle of Megalopolis in 330 B.C., and no other attempt was made by the Greeks to recover their liberty for nearly 100 years. At the close of the wars which followed the death of Alexander, and which resulted in the division of his empire, Greece remained with Macedonia.

The last efforts of the Greeks to recover their independence proceeded from the Achæans, who held the northern strip of the Peloponnesus. This tribe is frequently mentioned by Homer as taking a very prominent part in the Trojan war; but during the historical period of Greece they for the most part kept aloof from the quarrels of the other states, and did not even furnish assistance in repelling the Persian invasion. They had taken part, though reluctantly, in the Peloponnesian war on the side of Sparta, and had shared in the defeat of Megalopolis in 330 B.C. In the course of the first half of the 3d century B.C. several of the Achæan towns expelled the Macedonians, and revived an ancient confederacy, which was now known as the Achæan League. About the middle of this century the league was joined by the town of Sicyon, the native city of Aratus, who soon after became its leading spirit. Through his influence it was joined also by Corinth, and then it began to aim at acquiring the supremacy throughout the Peloponnesus, and even throughout the whole of Greece, as well as at delivering Greece from the Macedonian yoke. In following out the first of these aims Aratus and the league came into collision with Sparta, which at that time happened to be governed in near succession by two kings, Agis IV. (244–240) and Cleomenes (236–220), who had both something of the old Lycurgan spirit in them. These, then, naturally looked with jealousy on the efforts of Aratus, and during the reign of Cleomenes a war broke out between Sparta and the Achæan League. The league was at first worsted, and was only finally successful when Aratus, forgetting the ultimate end of his efforts in the pursuit of that which he had more immediately in view, called in the aid of the Macedonians. In the battle of Sellasia, in 222 B.C., Cleomenes was defeated and compelled to take to flight, and the Macedonians became masters of Sparta. Aratus died in 213, and his place was taken by Philopœmen, "the last of the Greeks," who roused the league once more to vigorous efforts, and gradually succeeded in making it in some degree independent of Macedonia.

About this time the Romans, who had just come out victorious from a second war with Carthage, in which they had had to contend with Hannibal, found an occasion to interfere in the affairs of Greece. Philip V. of Macedon had allied himself during this war with Hannibal, and, accordingly as soon as the war was concluded, the Romans sent over Flamininus to punish him for so doing, and in this war with Philip the Romans were joined by the Achæan League. Philip was defeated at the battle of Cynoscephalæ in 197 B.C., and was in consequence obliged to agree to a peace, in which he recognized the independence of Greece. To gratify the Greek vanity Flamininus proclaimed the deliverance of Greece from the Macedonian yoke at a celebration of the Isthmian games in 196 B.C.; but the Greeks soon felt that they had only exchanged masters, that they were in reality, although not in name, as much in subjection to them as they had ever been to the Macedonians. On this account the Ætolians, who had formed a league similar to that of the Achæans, appealed for assistance against the Romans to Antiochus the Great, king of Syria, one of the kingdoms which had been formed out of the empire of Alexander. The appeal was listened to; but the help afforded was useless, for Antiochus was defeated in a bloody battle at Magnesia in Asia Minor in 190 B.C. The Ætolians were compelled to pay a money indemnity, and to sacrifice some of their art treasures.

By this time the Achæan League was unquestionably supreme over all other powers within Greece, having been joined by all the states of the Peloponnesus. But the league itself was in reality subject to Rome, the senate of which assumed the right of regulating its proceedings; and on one occasion, in 168 B.C., on the conclusion of a war waged by the Romans against Macedonia, the former carried off into Italy 1,000 of the noblest Achæans, on the pretext that they had furnished assistance to the Macedonians. Such was the condition of affairs until 147 B.C., when the league openly resisted a demand made by the Roman senate, that Sparta, Corinth, Argos, and other cities, should be separated from it, in consequence of which a war ensued, which was concluded in 146 B.C. by the capture of Corinth by the rude consul Mummius.

The independence of Greece was virtually gone with the fall of Corinth. From this date the prosperity of her cities rapidly declined, and the last sparks of the ancient Greek patriotism and love of independence became extinguished. The various cities still retained, however, something of the qualities for which they had been remarkable at the height of their glory. Athens was still one of the centres of culture, and the cradle of all kinds of new speculations. Many Athenians left their native city and made a livelihood, although they gained little esteem, among the Romans, as artists and scholars, actors and dancers, poets and wits. The citizens of Sparta continued to gratify their thirst for warfare as well as their covetousness by serving as mercenaries in foreign armies. Corinth was still the home of luxury and vice.

From the date above mentioned Greece remained attached to the Roman empire. On the division of the Roman empire it fell of course to the eastern or Byzantine half. From 1204 to 1261 it formed a part of the Latin Empire of the East, and was divided into a number of feudal principalities. In the latter year it was reannexed to the Byzantine empire, with which

it remained till it was conquered by the Turks between 1460 and 1473. In 1699 the Morea was ceded to the Venetians, but was recovered by the Turks in 1715. (For the history of the present kingdom of Greece, see GREECE, MODERN.) Consult: Thirlwall, 'History of Greece'; Grote, 'History of Greece'; Bury, History of Greece' (1900).

Cosmogony and Religion.— Nowhere did polytheism develop itself into a brighter and more beautiful system than among the ancient Greeks. It was this circumstance no doubt that led the Romans, when they became acquainted with the literature and religion of the Greeks, to blend the Greek system with that of the ancient Italians, identifying the Greek deities with those of their own pantheon. In this way the Greek and Italian deities came to be confounded.

According to the view of the origin of all things which in course of time grew up among the Greeks, the universe was in the beginning a formless mass, Chaos (confusion), from which arose the "broad-bosomed" Earth (Greek, *Gaia, Gē;* Latin, *Tellus*), the Lower World (Tartarus), the darkness of Night (Greek, *Nux;* Latin, *Nox*), the parent of Light, and the formative principle of Love (Greek, *Erōs;* Latin, *Amor*), all of which were regarded as independent divinities. From the womb of the Earth proceeded the Heaven (Greek *Ouranos;* Latin, *Cœlum*) and the Ocean, and afterward the Titans, creatures of superhuman size and strength, who formed the first dynasty of gods. The Titans were succeeded by a more genial race of divinities endowed with intellectual as well as physical qualities, who subdued the Titans, and subsequently the Giants, another race whom the Earth produced after the loss of her first brood. In this second dynasty of gods the supreme ruler was Zeus (Jupiter or Juppiter), the son of Kronos (Saturn), who after the subjugation of the Titans and Giants ruled in Olympus over "the middle air," while his brother Pluto reigned over the dark kingdom of the lower world (Hades, Tartarus, Orcus), and Poseidōn (Neptune), armed with his trident, ruled in the sea. Like reverence was paid to Hēra (Juno), the sister and wife of Zeus, and the queen of Heaven, the virgin Pallas Athēnē (Minerva), a goddess armed with helmet and shield, and worshipped as the patroness of all intellectual employments and useful inventions, to the two children of Lētō (Latona), Apollo, the leader of the Muses (hence called Musagētēs) and the protector of the fine arts, and his sister, the chaste huntress Artemis (Diana), the goddess of the moon, to the daughter of Zeus, Aphroditē (Venus), the goddess of love, Ares (Mars), the god of war, Hermēs (Mercury), the herald of the gods, and others besides. In addition to these there was an innumerable host of inferior deities (Nymphs, Nereids, Tritons, Horai, Sirens, Dryads and Hamadryads, etc.), who presided over woods and mountains, fields and meadows, rivers and lakes, the seasons, etc. There was also a race of heroes or demigods (Heracles or Hercules, Perseus, etc.) tracing their origin from Zeus, and forming a connecting link between gods and men, while on the other hand the Satyrs formed a connecting link between the race of men and the lower animals. According to a plausible theory, now less generally held than formerly, these gods and demigods are nothing else than the personified objects of nature (the Sky or Upper Air, the Sun, the Ocean, the Air in Motion, etc.), and were originally not conceived as personified, in the strict sense of the term, that is, as clothed in a human form, but simply as the objects themselves, to which the earliest races everywhere attributed a conscious existence like their own, and that the mythological tales relating to these deities and heroes were in their simplest form the natural expression of what human beings in their infancy believed to be done and felt by the very things which they saw. Such is the theory of Max Müller, Mr. Cox, and others; but it will be more appropriately expounded in the article Mythology (q.v.).

With regard to the inculcation of religious beliefs, and the practice of religious duties among the Greeks, the most striking thing to remember is that they had no separate class appointed to perform these functions. The priests were in no sense preachers of doctrines, but merely hierophants, or exhibitors of sacred things, of rites, symbols, and images. They showed how the gods were to be worshipped, or more usually how a particular god was to be worshipped; but it was not their office to teach theological doctrine.

Greek Language and Writing.— The language which we call Greek belongs, as is well known, to the Indo-European or Aryan family of tongues, being akin to the Sanskrit, Persian, Latin, Celtic, Slavonic, and Germanic languages, including of course English. Out of Greece it was spoken in a great part of Asia Minor, of the south of Italy and Sicily, and in other regions which were settled by Grecian colonies. From the great number of Hellenic tribes of the same race it was to be expected that there would be different dialects, the knowledge of which is the more necessary for becoming acquainted with the Greek language, since the writers of this nation have transmitted the peculiarities of the different dialects in the use of single letters, words, forms, terminations, and expressions, and that not merely to characterize more particularly an individual represented as speaking, but even when they speak in their own person. It is customary to distinguish three leading dialects, according to the three leading branches of the Greeks, the Æolic, the Doric, and the Ionic, to which was afterward added the mixed Attic dialect; besides these there are several secondary dialects. Akin to the Ionic is the so-called Epic dialect, that in which the poems of Homer and Hesiod are written, and which was afterward adopted by other epic writers. The Doric was rustic and harsh; the Ionic was the softest and most liquid. The Attic was the neatest, clearest and most precise in sound literation and idiom. The Æolic was spoken on the north of the Isthmus of Corinth (except in Megara, Attica, and Doris), in the Æolian colonies of Asia Minor, and on some of the northern islands of the Ægean Sea. The Doric was spoken in the Peloponnesus, in the Doric Tetrapolis, in the Doric colonies of Asia Minor, of Lower Italy (Tarentum), of Sicily (Syracuse, Agrigentum), and most purely by the Messenians; the Ionic in the Ionian colonies of Asia Minor, and on the islands of the Archipelago; and the Attic in Attica. In each of these dialects there are celebrated authors. The Ionic dialect is found pure

in some prose writers, especially Herodotus and Hippocrates. The Doric is used in the poems of Pindar, Theocritus, Bion, and Moschus. Little Doric prose remains, and that is mostly on mathematical or philosophical subjects. In Æolic we have fragments of Alcæus and Sappho. After Athens had obtained the supremacy of Greece, and rendered itself the centre of all literary cultivation, the masterpieces of Æschylus, Sophocles, Euripides, Aristophanes, Thucydides, Xenophon, Plato, Aristotle, Isocrates, Demosthenes, etc., made the Attic the common dialect of literature. Grammarians afterward distinguished the genuine Attic, as it exists in those masters from the Attic of common life, calling the latter the *common Greek* or *Hellenic* dialect; and even the later Attic writers, posterior to the golden age of the literature, were designated *Hellenes* or *common Greeks*. In this latter class are Theophrastus, Apollodorus, Polybius, Plutarch, and others. Many of the later writers, however, wrote genuine Attic, as Lucian, Ælian, and Arrian. Except the dramatists, the poets by no means confined themselves to the Attic; the dramatists themselves assumed the Doric, to a certain degree, in their choruses, for the sake of giving them additional solemnity, because the antique ode was of Doric tradition. They also used the epic or Æolic dialect in narrative passages of the drama where it recalled the recitations of the ancient Ionian rhapsode. Undoubtedly the Greek dialects were not, in the earliest times, so distinct from each other as they afterward became; and on this subject we may quote the words of Prof. Bury (Hist. of Greece, chap. i.): "There can be little doubt that the mixture of the Greeks with the native peoples had a decisive effect upon the differentiation of the Greek dialects. The dialects spoken by the first settlers in Thessaly, in Attica, in Arcadia, have some common characteristics which tempt us to mark them as a group, and distinguish them from another set of dialects spoken by Greek folks which were to appear somewhat later on the stage of history. We may conjecture that the first set of invaders spoke in their old home much the same idiom; that this was differently modified in Thessaly and Bœotia, in Attica and Argolis, and the various countries where they settled; and that many of the local peculiarities were developed in the mouths of the conquered learning the tongue of the conquerors." It results that to have a thorough knowledge of the Greek language we must follow out historically as far as possible the course of its formation, extending our view over all the varied forms of the dialects — a labor which this language, so rich in classic models of every kind, so perfect, so flexible, so expressive, so sweet in its sound, so harmonious in its movements, and so philosophical in its grammatical forms and whole structure, merits, and richly rewards.

When the Greeks became acquainted with the art of writing we do not know. In Egypt hieroglyphics were used more than 3,000 years before the Christian era, and the cuneiform writing of Assyria and Babylonia had a similar antiquity. In Crete writing was practised more than 2,000 years before Christ, it is believed, and among the Asiatic Greeks it was probably introduced 9 or 10 centuries before Christ. According to the writer above quoted: "Perhaps the earliest example of a Greek writing that we possess is on an Attic jar of the 7th century; it says the jar shall be the prize of the dancer who dances more gaily than all the others. But the lack of early inscriptions is what we should expect. The new art was used for ordinary and literary purposes long before it was employed for official records. It was the great gift, which the Semites, who themselves derived it from Egypt, gave to Europe." According to the legend it was Cadmus the Phœnician who introduced the alphabet into Greece; and it is an undoubted fact that the most of the Greek letters are derived from the Phœnician ones. The Greek alphabet possesses the following 24 letters: Α, α (alpha), a; Β β (beta), b; Γ, γ (gamma), g; Δ, δ (delta), d; Ε, ϵ (epsilon), ĕ; Ζ, ζ (zeta), z; Η, η (eta), ē; Θ, θ (theta), th; Ι, ι (iota), i; Κ, κ (kappa), k; Λ, λ (lambda), l; Μ, μ (mu), m; Ν, ν (nu), n; Ξ, ξ (xi), x; Ο, ο (omicron, i. e. small o), ŏ; Π, π (pi), p; Ρ, ρ (rho), r; Σ, σ, ς (sigma), s; Τ, τ (tau), t; Υ, υ (upsilon), u, commonly transliterated by y; Φ, φ (phi), ph; Χ, χ (chi), ch guttural; Ψ, ψ (psi), ps; Ω, ω (omega, or great *o*), *ō*. There are also marks indicating accent, a rough and a smooth "breathing," the former equivalent to *h* initial before a vowel; but no *j*, *v*, *w*, etc. The alphabet originally introduced into Greece is said to have consisted of but 16 letters; 4 (Θ Ξ Φ Χ) are said to have been invented by Palamedes during the Trojan war, and 4 more (Ζ Η Ω Ψ) by Simonides of Ceos. That the 8 letters mentioned are more modern than the others is certain, partly from historical accounts, partly from the most ancient inscriptions. It remains to remark that the Greeks originally wrote from right to left; then *boustrophedon*, that is, alternately from right to left and left to right; and finally always from left to right.

Greek Literature.— The origin of Greek literature, that is, of the intellectual cultivation of the Greeks as contained in written works, is lost in an almost impenetrable obscurity. Though there existed in Greece, in earlier times, no actual literature, there probably was by no means a want of what we may not improperly call *literary cultivation*, if we free ourselves from the prejudice that a literature must of necessity be embodied in written alphabetical characters. The *first period* of Grecian cultivation which extends to the movement known as the invasion of the Peloponnesus by the Heraclidæ and Dorians, and the great changes produced by it, and which we may designate by the name of the *Ante-Homeric period*, was no doubt utterly destitute of literature; but it may be questioned whether it was also destitute of all that culture which we are accustomed to call *literary*. The fables which are told of the intellectual achievements of this period may have a certain basis of truth. Among the promoters of literary cultivation in this time we must distinguish three classes: (1) Those of whom we have no writings, but who are mentioned as inventors of arts, poets, and sages: Amphion, Demodocus, Melampus, Olen, Phemius, and Prometheus. (2) Those to whom are falsely attributed works no longer extant: Abaris, Aristeas, Chiron, Epimenides, Eumolpus, Corinnus, Linus, and Palamedes. (3) Those to whom writings yet extant, which, however, were productions of later times, are attributed: Dares, Dictys, Horapollo, Musæus, Orpheus, and the authors of the

Sibylline oracles. This is not the place to inquire whether any and how much of these writings is genuine. It is enough that the idea of such a forgery proves a belief in the existence of earlier productions. And how could the next period have been what it was without previous preparation? If we may thus infer what must have been in order that the succeeding period should be what it was, we learn also from the various traditions of the Ante-Homeric period that there existed in it institutions which, through the means of religion, poetry, oracles, and mysteries, had no small influence on the civilization of the nation and the promotion of culture; for the most part, indeed, in Oriental forms, and perhaps of Oriental origin; and that these institutions, generally of a priestly character, obtained principally in the northern parts of Greece, Thrace, and Macedonia. We must here remark that intellectual cultivation did not prosper at once in Greece, nor display itself simultaneously among all the tribes; that the Greeks became Greeks only in the process of time, and some tribes made more rapid progress than others.

About 80 years after the Trojan war new commotions and a new migration began within the borders of Greece. A portion of the inhabitants emigrated from the mother country to the islands and to Asia Minor. This change was in the highest degree favorable to Grecian genius; for the new settlements, abounding in harbors, and destined by nature for commerce and industry, afforded them not only a more tranquil life, but also a wider field for refinement, and gave rise to new modes of life. The ancients ascribed to the colonies in Ionia and the rest of Asia Minor the character of luxury and voluptuousness. The blue sea, the pure sky, the balmy air, the beautiful prospects, the finest fruits, and most delicious vegetables in abundance, all the requisites of luxury, here united to nourish a soft sensuality. Poetry and philosophy, painting and statuary, here attained their highest perfection; but great and heroic deeds were oftener celebrated than performed. Near the scene of the first grand national enterprise of the Greeks — the Trojan war — it was not strange that the interest this event excited should be lively, and that it should take a powerful hold of the imagination. Poetry thus found a subject, in the treatment of which it necessarily assumed a character entirely distinct from that of the former period. Among all nations heroic poetry has flourished with the spirit of heroism. The heroes were here followed by the bards, and thus the epopee was formed. We therefore call this *second period* the *epic age* of the Greeks. The minstrel (*aoidos*) now appears separated from the priest, but highly honored, particularly because the memory of the heroes lived in his verse; and poetry was the guardian of all the knowledge of preceding times, so long as traditions were not committed to writing. From its very nature the epopee must be historical, in an enlarged sense. Under such circumstances it is not strange that regular schools for poets were established; for the imagination of the first poet fired the imagination of others, and it was then, perhaps, believed that poetry must be learned like other arts — a belief to which the schools for priests, on which the schools for minstrels were probably modeled, contributed not a little. But they were minstrels in the strictest sense, for their traditions were sung, and the poet accompanied his verses on a stringed instrument. On every important occasion minstrels were present, who were regarded as standing under the immediate influence of the gods, especially of the Muses, who were acquainted with the present, the past, and the future. The minstrel, with the seer, thus stood at the head of men. But among the many minstrels which this age undoubtedly possessed, Homer alone has survived, whose name has always been associated with the two great epic poems, the 'Iliad' and 'Odyssey,' although in modern times the theory first promulgated by Wolf in 1795, that neither of these poems is the work of one man, has been accepted either entirely or with modifications by many scholars, and many others who contend for the unity of each of the two poems are yet inclined to believe that they were not both composed by the same individual. The latter opinion is not of modern origin, but divided also the Homeric scholars of ancient times. Several hymns, and a mock heroic poem called the 'Batrachomyomachia,' or the 'Battle of the Frogs and Mice,' are also ascribed to Homer, but on altogether insufficient grounds. From him an Ionian school of minstrels takes its name — the *Homeridæ* — who probably constituted at first, at Chios, a distinct family of rhapsodists, and who preserved the old Homeric and epic style, the spirit and tone of the Homeric verse. Much that was attributed to Homer may reasonably be assigned to them. A certain class of the followers of Homer are known by the name of the Cyclic poets, who began, however, to deviate materially from the Ionian epos, the historical element predominating more and more over the poetical. By Cyclus we understand the whole circle of traditions and fables, and not merely the events of the Trojan war. Cyclic poetry comprehended the whole compass of mythology; and we may, therefore, divide it into: (1) a cosmogonical; (2) a genealogical; and (3) a heroic Cyclus; in the latter of which there are two separate periods: (1) that of the heroes before; and (2) that of those after, the expedition of the Argonauts. To the first class belong the battles of the Titans and giants; to the second, the theogonies and herogonies. To the first period of the third class belong the Europia, several Heracleia and Dionysiacs, several Thebaids, Argonautics, Theseids, Danaids, Amazonica, etc. In the second period the poetry generally related to the Trojan war. To this belonged the Nostoi, which treated of the return of the heroes from Troy. The earliest of these Cyclic poets appeared about the time of the first Olympiad. A history of the gradual formation of their poetry cannot be given, because we have only very general accounts respecting them. But what we do know justifies us in concluding that between these historic poets and the Ionian school of minstrelsy something intervened, making, as it were, the transition. And we actually find this in the *Bœotian-Ascrean* school, which arose in European Greece, it is said, in the 8th century B.C. It derived its name from Ascra in Bœotia, the residence of Hesiod, who stood at its head, and by whom poetry was probably conducted back again from Asia Minor (for he was originally of Cyme in Æolia) to Greece. His

works also were at first preserved by rhapsodists. They were not arranged till a later period, when they were augmented by foreign additions; so that, in their present form, their authenticity is as doubtful as that of the poems ascribed to Homer. Of the 16 works attributed to him there have come down to us the 'Theogony,' the 'Shield of Hercules' (the fragment of a larger poem), and 'Works and Days' (a didactic work on agriculture), the 'Choice of Days,' intermixed with moral and prudential maxims, etc. The works of Homer and Hesiod acquired a canonical importance among the Greeks, and constituted, in a certain degree, the foundation of youthful education.

In the *third period*, the age of lyric poetry, of apologues and philosophy, our knowledge of Greek history gradually acquires a greater certainty. About the beginning of the epoch of the Olympiads (776 B.C.) there ensued a true ebb and flood of constitutions among the small states of Greece. After numerous vicissitudes of power, during which the contending parties persecuted each other for a long time with mutual hatred, republics, with democratical constitutions, finally sprang up, which were in some measure united into one whole by national meetings at the sacred games. The spirit prevalent in such a time greatly favored lyric poetry, which now became an art in Greece, and reached the summit of its perfection at the time of the invasion of the Persians. Next to the gods, who were celebrated at their festivals with hymns, their country, with its heroes, was the leading subject of this branch of poetry, on the character of which external circumstances seem to have exercised no slight influence. The mental energies of the nation were roused by the circumstances of the country; and the numerous wars and conflicts, patriotism, the love of freedom, and the hatred of enemies and tyrants, gave birth to the heroic ode. Life, however, was at the same time viewed more on its dark side. Thence there was an intermingling of more sensibility in the elegy, as well as, on the other side, a vigorous reaction, in which the spirit of ridicule gave rise to the iambus (satire). In everything there was a more powerful impulse toward meditation, investigation, and labor for the attainment of a desired condition. The Golden Age, the gift of the gods, was felt to have departed. Whatever man discovered in future was to be the fruit of his own efforts. This feeling showed that the age of manhood had arrived. Philosophy had become necessary, and attained continually a greater development. It first spoke in maxims and gnomes, in fables and in dogmatic precepts. Lyric poetry next gave utterance to the feelings excited by the pleasures of earth. Of those who gained a reputation in this way, as well as by the improvement of music and the invention of various forms of lyric poetry, history presents us the names of Archilochus of Paros, inventor of the iambus; Tyrtæus, author of war songs; Callinus of Ephesus, inventor of the elegiac measure (all of whom flourished in the 7th century B.C.); Terpander of Antissa, in Lesbos (675 B.C.); Simonides of Amorgos (664), the second of the three principal iambic poets of Greece; Alcman the Lydian, and Arion of Methymna, said by Herodotus to have invented the dithyrambus (both flourished about 630 B.C.); Sappho, Alcæus, and Erinna, all natives of Lesbos, the first two of Mitylene, and all of whom flourished about 610 B.C.; Mimnermus of Colophon (flourished from about 634 to 600 B.C.); Stesichorus of Himera (600); Ibycus of Rhegium (lived about 540 B.C. at the court of Polycrates of Samos); Anacreon of Teos (lived first at the court of Polycrates, afterward at that of Hipparchus at Athens); Hipponax of Ephesus (540–520), the third great iambic poet; Lasus of Hermione (520); Simonides of Ceos (fl. 500); his contemporary, Timocreon of Rhodes; Corinna of Tanagra (490), the friend and instructress of Pindar (522–442). As gnomic writers, Theognis of Megara and Phocylides of Miletus deserve to be named (both of whom flourished about 540 B.C.); as a fablist, Æsop (570 B.C.). In the order of time several belong to the following period, but are properly placed here, on account of their connection.

In the period of 550–500 B.C. traditions were first committed to writing in prose, and Cadmus of Miletus (540), Acusilaus the Argive, Hecatæus of Miletus (500), Hellanicus of Mitylene, and Pherceydes of Scyros, are among the oldest historical writers (450). These are known as the logographers (*logographoi*), a name given to them by Thucydides. After them appeared Herodotus (born 484), the Homer of history. His example kindled Thucydides (born 471) to emulation, and his eight books of the history of the Peloponnesian war make him the first philosophical historian, and a model for all his successors. If his conciseness sometimes renders Thucydides obscure, in Xenophon (born about 444), on the contrary, there prevails the greatest perspicuity; and he became the model of quiet, unostentatious historical writing. These three historians are the most distinguished of this period, in which we must, moreover, mention Ctesias (400), Philistus (363), and Theopompus (340).

An entirely new species of poetry was created in this period. From the thanksgiving festivals, which the country people solemnized after the vintage, in honor of Dionysus (Bacchus), with wild songs and comic dances, arose, especially in Attica, the drama. By degrees variety and a degree of art were given to the songs of the village chorus, and by and by an intermediate speaker was introduced, who related popular fables, while the chorus varied the eternal praises of Bacchus by moral reflections, as the narration prompted. These games of the feast of the vintage were soon repeated on other days. Solon's contemporary, Thespis, who smeared his actors, like vintagers, with lees of wine, exhibited at the cross ways or in the villages, on movable stages, stories sometimes serious with solemn choruses, sometimes laughable with dances, in which satyrs and other ridiculous characters excited laughter. Their representations were called tragedies (*tragōdiai*), that is, songs of the goat (so called either because the exhibition of a tragedy was in the earliest times accompanied by the sacrifice of a goat, or because a goat was the prize, or because the actors were clad in goat-skins) comedies (*kōmōdiai*, meaning either village songs, from *kōmē*, a village, or songs of revelry, from *kōmos*, revelry), festive dances and satirical actions (*drama satyricum*). These sports were finally exhibited, with much more splendor, on the stages of the towns, and acquired a more and more distinct character by their peculiar tone

and morality. Instead of an intermediate speaker, who related his story extemporaneously, Æschylus (525–456) first substituted actors, who repeated their parts by rote; and he was thus the actual creator of the dramatic art, which was soon carried to perfection; tragedy by Æschylus, Sophocles (495–406) and Euripides (480–406); comedy by Cratinus (519–422), Eupolis (fl. 449), Crates, but especially by Aristophanes (about 444–380). Under the government of the Thirty Tyrants the freedom which comedy had possessed, of holding up living characters to ridicule, was restricted, and the middle comedy was thus gradually formed, in which the chorus was abolished, and, with delineations of general character, characteristic masks were also introduced. The mimes of Sophron of Syracuse (460–420), dramatic dialogues in rhythmical prose, formed a distinct species, in connection with which stands the Sicilian comedy of Epicharmus (about 540–450).

Eloquence, the necessary outcome of the democratic institutions of many of the Greek states, likewise flourished during this period, and was speedily elevated to the rank of a fine art. Antiphon (440), Lysias (458–378), Isocrates (436–338), Isæus (420–348), Demosthenes (about 385–322), Æschines (389–314), were renowned masters of this art. We still possess the admired masterpieces of several of these orators. How near rhetoric was then to triumphing over poetry is manifested in Euripides, and there is no question that it had a considerable influence on Plato and Thucydides. Mathematics was now cultivated, and geography served to illustrate history. Astronomy is indebted to the Ionic school, arithmetic to the Italic, and geometry to the Academic school for many discoveries. As mathematicians, Meton, Euctemon, Archytas of Tarentum, Eudoxus of Cnidus, were celebrated. Geography was particularly enriched by voyages of discovery, which were occasioned by commerce; and in this view Hanno's voyage to the western coast of Africa, the Periplus of Scylax (a description of the coasts of the Mediterranean), and the discoveries of Pytheas of Massilia in the northwest of Europe, deserve mention. The study of nature was likewise pursued by the philosophers; but the healing art, hitherto practised by the Asclepiadæ in the temples, constituted a distinct science, and Hippocrates (about 460–357) became the creator of scientific medicine.

The following period is usually called the *Alexandrine,* and might be characterized as the *systematizing* or *critical period.* Athens did not, indeed, cease to sustain its ancient reputation; but during the greater part of the period Alexandria was in reality the leading Greek city. From this and other causes the spirit of Grecian literature necessarily took another turn. Greece was now under a foreign yoke; great creative geniuses no longer arose either in the home country or in the colonies; and the use of an immense library tended to make erudition triumph over the free action of mind, which, however, could not be immediately overborne. In philosophy, Plato's acute and learned disciple, Aristotle (384–322), appeared as the founder of the Peripatetic school, which gained distinction by enlarging the territory of philosophy, and by its spirit of system. He separated logic and rhetoric, ethics and politics, physics and metaphysics, and applied philosophy to several branches of knowledge; thereby producing economics, pedagogics, and poetics. He invented the philosophical syllogism, and gave philosophy the form which it preserved for centuries. His disciple Theophrastus (died 287 B.C.) followed his steps in the investigation of philosophy and natural history. But the more dogmatic was the philosophy of Aristotle, the more caution was requisite to the philosophical inquirer, and the spirit of doubt was salutary. This was particularly exhibited in the system of skepticism which originated with Pyrrho of Elis (330). A similar spirit subsisted in the middle and new academics, of which Arcesilaus (241) and Carneades (155) were the founders. The Stoic school, founded by Zeno of Citium in Cyprus (342–270), and the Epicurean, of which Epicurus (299–279) was the founder, were chiefly remarkable for the effect that they had in the development of moral speculation in opposite directions, which gradually brought about a great difference in the practice of the adherents of the opposite schools. Mathematics and astronomy made great progress in the schools at Alexandria, Rhodes, and Pergamus. And to whom are the names of Euclid (323–283), Archimedes (287–212), Eratosthenes (276–196), and Hipparchus (160–145) unknown? The expeditions and achievements of Alexander furnished abundant matter to history; but, on the whole, it gained in extent, not in value, since a preference for the wonderful over the actual had now become prevalent. The more gratifying, therefore, is the appearance of Polybius of Megalopolis (204–122), who is to be regarded as the author of the true method of historical exposition, by which universal history acquired a philosophical spirit and a worthy object. Geography, which Eratosthenes made a science, and Hipparchus united more closely with mathematics, was enriched in various ways. To the knowledge of countries and nations much was added by the accounts of Nearchus Agatharchides and others. With respect to poetry many remarkable changes occurred. In Athens the middle comedy gave place not without the intervention of political causes to the new which approaches to the modern "comedy of manners." (See DRAMA.) Among the many poets of this class Menander (342–291) and Philemon (330) were eminent. To this period also belong the celebrated idyllic poets Theocritus (270), and his contemporary Bion, as well as Moschus, who lived about 20 years later. The other kinds of poetry did not remain uncultivated; we may mention the learned poetry of Callimachus and of Lycophron, the epic of Apollonius Rhodius, the didactic of Aratus and Nicander; but all these labors, as well as the criticisms of poetry and the fine arts, point to Alexandria; and we shall therefore pass them over in this place. (See ALEXANDRIAN SCHOOL.) The Septuagint (q.v.) or Greek translation of the Old Testament was a work of scholars of the Alexandrian school. The period subsequent to 146 B.C. is known as the Græco-Roman. Polybius may be placed here as well as the other historians, Diodorus Siculus and Dionysius of Halicarnassus; while in the Christian era we have Josephus, Arrian, Appian, Herodian; the biographies of Plutarch, Diogenes Laertius, and Philostratus, the geographies of Strabo and Pausanias; the astronomy and geography of Ptolemy;

the informatory works of Athenæus, Ælian, and Stobæus; the medical works of Galen; the satirical works of Lucian; and the Greek romances best represented in Heliodorus, Achilles Tatius, and Chariton. See BYZANTINE LITERATURE.

The following are among the best works on Greek literature: K. O. Müller's 'Geschichte der griechischen Litteratur' (4th ed. 1882–4); Bergk's 'Griechische Litteraturgeschichte' (1892–4); Bernhardy's 'Grundriss der griechischen Litteratur' (new ed. 1892); Mure's 'Critical History of the Language and Literature of Ancient Greece' (1854–60); Mahaffy's 'Classical Greek Literature' (1890); Jevons' 'History of Greek Literature' (1890); Croiset's 'Histoire de la littérature grècque (1889–95); Susemihl's 'Geschichte der griechischen Litteratur in der Alexandrinerzeit' (1891–2).

Greece, Modern (Greek *Hellas*), a kingdom in the southeast of Europe, bounded on the north by Turkey, and on all other sides by the sea — the Ionian Sea on the west, the Mediterranean proper on the south, and the Ægean Sea on the east. The mainland forms two chief portions, united by the narrow Isthmus of Corinth; a northern, called Northern Greece or Livadia, and a southern peninsula, called the Peloponnesus or Morea. By far the largest island is Eubœa, only separated from the mainland of Livadia by the narrow channel of Euripo. The other islands form several groups: The northern Sporades on the northeast of Eubœa including Skiathos, Skopelos, Khiliodromia, Pelagonisi, Sarakinon or Peristeri, and Skyros; the western Sporades, chiefly in the Gulf of Egina, or between it and the Gulf of Nauplia, including Hydra, Spetsæ, Poros, Egina, and Salamis or Koluri, the Cyclades; and the Ionian Islands. (See GREECE, ANCIENT.) The capital and largest town is Athens.

Physical Features.— See GREECE, ANCIENT.

Divisions.— Greece is politically divided into 16 nomarchies, which are again subdivided into eparchies, and these again into demes. The following table gives the names of the nomarchies, with the area of each of them, and the population according to the returns for 1896:

Nomarchies		Area in sq. m.	Pop. 1896.
Northern Greece:	Attica and Bœotia...	2,472	313,069
	Phocis and Phthiotis.	2,044	147,297
	Acarnania and Ætolia	3,013	170,565
Peloponnesus:	Argolis and Corinth.	1,442	157,578
	Achaia and Elis.....	1,901	236,251
	Arcadia	2,020	167,092
	Messenia	1,221	205,798
	Laconia	1,679	135,462
Islands:	Eubœa and Sporades.	2,216	115,515
	Cyclades	923	134,747
	Corfu	431	124,578
	Zante	277	45,032
	Cephalonia	302	83,363
Thessaly:	Arta	395	39,144
	Trikkala	2,200	176,773
	Larissa	2,478	181,542
	Total............	25,014	2,433,806

By the law of 17 July 1899 there is a new division into 26 nomarchies, namely: Attica, Bœotia, Phthiotis, Phocis, Ætolia and Acarnania, Eurytania, Larissa, Magnesia, Trikkala, Karditsa, Arta, Achaia, Elis, Eubœa, Cyclades, Kerkyra (Corfu), Leucas, Kephallenia (Cephalonia), Zacynthos (Zante). These are subdivided into 69 districts and 442 communes.

Climate.— In general the first snow falls in October and the last in April. During the summer rain scarcely ever falls, and the channels of almost all the minor streams become dry. The air is then remarkably clear, and a month will sometimes pass away without a cloud being seen. A sudden change, however, takes place toward the end of harvest. Rain becomes frequent and copious; and the streams which had been dried up not only fill their channels, but frequently overflow them, and lay considerable tracts under water. In this way stagnant pools and marshes are occasionally formed, which give rise to intermittent fevers. Compare GREECE, ANCIENT (*Climate*).

Vegetation, Agriculture, etc.— The cultivated land in Greece has recently been estimated at rather more than 5,563,100 acres. There are besides 5,000,000 acres of pasture land, and 3,000,000 acres of waste land. The draining of Lake Copais redeems 60,000 acres of land, which the company divides into holdings of from 5 to 50 acres. English agricultural machinery is being introduced, but still agriculture is in a backward state.

Thessaly is the richest portion of Greece agriculturally. The condition of the agricultural population is said to be very satisfactory. The principal cereal crops are wheat, barley, and maize, but the quantity raised is not sufficient, and much grain is imported. All the fruits of the latitude are grown — figs, almonds, oranges, citrons, melons, etc.— in abundance and of excellent quality, without receiving any great share of attention. The vine also grows vigorously, and considerable quantities of wine are made, some of the sorts being of high quality. But a much more important product of Greece, especially on the coasts of the Peloponnesus, and in the islands of Cephalonia, Zante, Ithaca, and Santa Maura, is the Corinthian grape or currant, the export of which has increased in value from $7,558,350 in 1898 to $8,238,118 in 1900. Another important object of cultivation is the olive, for which both the soil and the climate are alike favorable. The culture of the mulberry for the rearing of silk-worms is carried on to some extent. Some good tobacco is grown. The forests contain, among other trees, the oak (*Quercus Ægilops*) which yields the valonia of commerce. The live stock are neither numerous nor of good breeds. The raising of artificial grasses for their maintenance may be said to be unknown, and the scanty herbage which natural pasture affords must be of little avail. Asses and mules are more numerous than horses; cattle are comparatively few; and the chief animals from which dairy produce is obtained are the sheep and the goat. The quantity of wool produced is considerable, but most of it is of a coarse description.

Manufactures, Trade, Communications, etc.— The manufactures are limited, but with all other branches of industry in Greece are increasing, and are furthered by high duties on imported goods. The employment of the steam-engine in manufacturing industries dates from about 1868, and is yet only developed to a small extent. Piræus is the chief industrial centre, having spinning and weaving factories for cotton, silk, and wool, machine-shops, paper-works, dyeworks, etc. Other centres are Syra, Corinth,

Nauplia, Patras, Larissa. Still, cottons and other textiles form by far the most important part of the imports of manufactured goods. Leather manufactures form an important branch of industry. Marble has been worked from the most ancient period in the quarries of the island of Paros. In 1871 the working of the ancient argentiferous lead mines of Laurion in Attica was resumed with good success; and quantities of manganese iron ore and zinc ore are also raised in this district. The most important branch of manufacturing industry is ship-building, which is carried on at various places. Much of the trade carried on is merely coasting, but the foreign trade also is of considerable extent. A large part of the foreign shipping of Greece is that which deals with the import of the manufactures of England, Germany, etc., into Greece, Turkey, and the Levant generally. In regard to this branch, the peculiar advantages which the Greeks possess in their knowledge of the languages, and acquaintance with the habits and wants, of the people of these countries, have been greatly in their favor. The chief ports of Greece are Piræus (population 42,169, the port of Athens), Syra, and Patras (population 37,958). The principal export is currants (very largely to Britain); but wine, olive-oil, dried figs, raisins, silver, lead, zinc ore, and manganese iron ore, tobacco, sponges, and other articles are also exported; the principal imports are cereals, coals, and cotton and woolen goods. The imports in 1891 were $27,800,260, the exports $21,497,040; in 1901 the imports were $27,773,010. The greatest hindrance to the development of Greece is the want of good roads, which are peculiarly necessary in so mountainous a country. Attention, however, has been directed to the supplying of this want, and there are now over 2,043 miles of roads. Among other public works which have engaged the energies of the Greeks are the construction and restoration of harbors, the erection of lighthouses, the execution of drainage works, etc. In 1883 there were only 58 miles of railways open, but in 1901 603 miles were open, and 300 were under construction. A ship canal across the isthmus of Corinth (4 miles) was opened in 1893.

Weights, Measures, and Money.— The French metric system of weights and measures has been introduced into Greece by the government, but the people still adhere to the old system. In the latter the standard lineal measure was the *pikē*, equal to three quarters of an English yard; the standard square measure was the *stremma*, nearly equal to .242 of an English acre; the standard weight was the *oke* = 2.80 pounds avoirdupois: 44 *okes* were equal to 1 *cantar*, or about 124 pounds avoirdupois. The weights and measures of the metric system are called royal, to distinguish them from the old weights and measures. In this system the French measures of length, millimetre, centimetre, decimetre, and metre are called respectively *gramma, daktylos, palamē*, and *pēcheus* (cubit). The kilometre is called a *stadion*, and the myriametre *skoinis*. The new or royal measures of surface are the square *pecheus* = the square metre, and the *stremma* = the are. The measures of capacity are the *kybos, mystron, kotylē, litra*, and *koilon*, respectively equal to the millilitre, centilitre, decilitre, litre, and hectolitre. The weights for gold, silver, and precious stones are the *kokkos, obolos*, and *drachmē*, respectively equal to the centigramme, decigramme, and gramme. The commercial unit of weight is the *mna* = 1,500 *drachmēs* = 1½ kilogramme. The *talanton* is equal to the quintal, and the *tonos* equal to the tonneau.

In 1875 Greece entered the monetary league of which the other members are France, Italy, Switzerland, and Belgium, and all the members of which have a monetary unit equal to the franc in value. The name of the Greek unit is the *drachma*, divided into 100 *lepta*, nominally equal to a franc but varying considerably in value.

Government and People.— As settled by the present constitution the throne is hereditary according to the law of primogeniture in the family of King George. The king must be a member of the Greek Orthodox Church. He attains his majority at the age of 18. The legislative authority is vested in a single chamber, called the Boulē, the members of which (proportioned in number to the amount of the population) are elected for four years by ballot by manhood suffrage. It meets every year on 1 November, unless called at an earlier date for special business. The executive power is exercised by the king through a responsible ministry. The Greek Orthodox Church alone is established, but all other forms of religion enjoy toleration. The highest ecclesiastical authority, subject to the king, is vested in a permanent synod, which sits at Athens, and consists of five members appointed by the king from the highest dignitaries of the Church. There is 1 metropolitan, who has his seat at Athens, 21 archbishops, and 29 bishops, who are presented and ordained by the synod, and confirmed and invested by the king. Justice is administered, on the basis of the French civil code, by a supreme court (*Areios Pagos*), which has its seat at Athens; five higher courts, one at Athens, one at Nauplia, one at Patras, one at Larissa, and one at Corfu; and a number of courts of primary resort (*Protodokeia*), in the principal towns. The public revenue, derived chiefly from direct taxes, customs, stamps, excise, monopolies, the rent of national property, etc., was estimated for 1900 at $18,519,755, and the expenditure at $17,687,135. Revenue for 1902 was estimated at $23,621,675, and expenditure at $23,621,680. Greece has a very large public debt. In 1899 the amount of this debt was about $152,500,000. A considerable portion of the debt incurred in recent years has been in the way of raising loans for the making of railways. Of the foreign debt one loan is guaranteed by Great Britain, France, and Russia, which have latterly had to pay the dividends on it, and which are now accordingly heavy claimants on Greece. The payment of the interest on its public debt has long been with Greece a matter of difficulty. Every male Greek on attaining the age of 21 years is liable to military service, his term being 2 years with the colors, 10 with the reserve, 8 in the national guard, and 10 in the national guard reserve. The army in 1900 numbered about 25,000 on a peace footing, expanding easily to 82,000 in time of war. The navy in 1903 consisted of 3 armorclad ships, 19 torpedo-boats, besides several unprotected gun-vessels and cruisers. The population contains a considerable intermixture of foreign stocks, among which the Albanese, or Arnauts, are the most numerous; but the great

GREECE.

1. The Academy at Athens. 2. The University at Athens.

majority, though not without some taint in their blood, are of genuine Greek extraction, and, both in physical and mental features, bear a marked resemblance to their celebrated forefathers. It is true that the degrading bondage to which they were subjected for centuries has sunk them far below their natural level, and too often substituted sycophancy and low cunning for the intellectual superiority which, in earlier and better times, displayed itself in immortal productions of the chisel and the pen; but that the original elements of greatness still exist has been proved by the noble struggles which they have made for independence. The educational system of Greece, organized in 1834 by George Gennadius, one of the leaders of the war of independence, is very complete. There are three grades of schools, the demotic or primary national schools, the Hellenic or secondary grammar schools, and the gymnasia, in which, it is asserted, the range and the level of the teaching are much the same as in a German gymnasium or in the upper parts of our public schools. In all three grades of schools education is gratuitous, and in the primary schools it is compulsory on all children between 5 and 12. There is a university at Athens, attended by nearly 3,000 students, many of whom come from districts under the rule of the Sultan. Thus far, however, education seems to be actually diffused among the people only to a limited extent, though the numbers that receive a university education are so great that many such young men find themselves without any proper sphere of employment, and are obliged to adopt the career of politician and place-hunter. Many of these are now, however, said to be finding better ways of turning their education to account through the rapid development of trade and industry. The national dress of the Greeks resembles the Albanian costume. In the men it consists of a tight jacket, generally scarlet, a white linen kilt in numerous folds, a bright-colored sash round the waist, and embroidered gaiters; in the women it consists of a vest or jacket fitting close to the shape, and a skirt, on the head a kind of fez or skull-cap.

History.— From the year 1715 (see preceding article) till 1821 the Greeks were subject to the domination of the Turks. In 1770, and again in 1790, they made attempts at insurrection, which, however, were speedily frustrated. In the early years of the 19th century a secret society was formed for the purpose of effecting their liberation from the galling yoke, and in 1821 they found an opportunity of breaking out into another insurrection, which in the end proved successful. In that year Ali, the pasha of Janina, revolted against the Sultan Mahmoud II., and secured the aid of the Greeks by promising them their independence. The rising of the Greeks took place on 6 March, under Alexander Ypsilanti, and on 1 Jan. 1822 they published a declaration of independence. In the same year Ali was assassinated by the Turks, but the Greeks nevertheless continued the struggle that they had begun, and in which they were encouraged by the sympathy of nearly all the nations of Europe. Among the most distinguished of their leaders were Marcos Bozzaris, Capo d'Istria, Constantine Kanaris, Kolocotroni, Miaulis, Mavrocordato, Mavromichaelis, etc. In 1823 they were joined by Lord Byron, who, during the last year of his life, did all in his power to further their cause by his wealth, as well as by his active efforts on their behalf. Unfortunately he died in April of the following year. In 1825, the Turks having called to their aid Mehemet-Ali, the pasha of Egypt, the latter sent his son, Ibrahim Pasha, whose talents secured them the success that they had hitherto been unable to attain. Tripolitza, the capital of the Morea, was taken, as was also Missolonghi, in spite of the valor of the Suliote mountaineers. It was about this time that the Greek patriots received the aid of the English admiral Lord Cochrane, who organized their fleet, and of the French colonel Fabvier, who instructed their army in the system of European tactics. In spite of this, however, the Turks continued to triumph everywhere, and resisted all the pressure that was put upon them by other European powers to make concessions. A treaty was then concluded at London (6 July 1827) between Britain, France, and Russia, for the pacification of Greece, and when the mediation of these three powers was declined by the Sultan, their united fleets, under Admiral Codrington, attacked and annihilated the Turkish fleet off Navarino, 20 Oct. 1827. In the beginning of the following year (1828) Count Capo d'Istria became president of the state, and later on in the same year Ibrahim Pasha was forced to evacuate Greece. At last, on 3 Feb. 1830, a protocol of the allied powers declared the independence of Greece, which was recognized by the Porte on 25 April of this year. The new member of the states of Europe received from the allies a monarchical form of government, and offered the crown to Leopold, Prince of Saxe-Coburg, and when he refused it, to Otho, a young prince of Bavaria. The latter accepted the offer, and was proclaimed king of the Hellenes at Nauplia, on 30 Aug. 1832. The power of the king was at first almost absolute, and his arbitrary measures, and more especially the preponderance which he gave to Germans in the government, soon made him unpopular. At the same time the finances of the kingdom were in a very embarrassed condition, and a general uneasiness prevailed. In 1843 a rebellion took place, after which a constitution was drawn up. But Otho was after that no more popular than before, and after the outbreak of another rebellion in February 1862, he saw himself compelled to abdicate the throne (24 October). A provisional government was then set up at Athens, and the National Assembly after declaring that the throne had been forfeited by Otho, offered it in succession to Prince Alfred, of England, and Prince William George, of Denmark. The latter accepted it, and 30 March 1863 was proclaimed as King George I. At the end of that year a constituent assembly was elected for the purpose of framing a new constitution, and the result of its labors was the constitution which is still in force. In 1864 an addition was made to the small kingdom by the annexation of the Ionian Islands, which had hitherto formed an independent republic under the protection of Britain. From the first Greece has been watching for an opportunity of extending its frontier northward, so as to include the large Greek population in Thessaly and Epirus. In January 1878, during the Russo-Turkish war, Greek troops were moved into Thessaly and Epirus to the assistance of their brethren who had risen there, but on the remonstrance of England these troops were with-

drawn. The Treaty of Berlin made no definite provisions for any extension of Greek territory, but in 1881 Turkey had to cede about 5,000 square miles of Thessaly to Greece. After the union of eastern Roumelia with Bulgaria, in 1885, war with Turkey was only prevented by the great powers. In 1896 an insurrection of the Christians in Crete led to the interference of Greece and to war with Turkey. The Turks speedily drove back the Greeks from the northern frontier and overran Thessaly; and Greece was enabled only through the efforts of the great powers to obtain reasonable terms of peace. The recent internal political history of Greece relates mainly to her financial obligations. After the expulsion of the Turkish troops from Crete in 1898 Prince George was appointed high commissioner of the island.

Modern Greek Language and Literature.— The Greek language seems to have preserved its purity longer than any other known to us; but a deadly blow was inflicted when the Greeks were enslaved by the fall of Constantinople (1453 A.D.). All the cultivated classes, who still retained the pure Greek, the language of the Byzantine princes, either perished in the conflict or took to flight, or courted the favor of their rude conquerors, by adopting their dialect. In the lower classes only did the common Greek survive (the *koinē, dēmodēs, haplē, idiotikē dialektos*) the vulgar dialect of the polished classes, the traces of which occur, indeed, in earlier authors, but which first appears distinctly in the 6th century. This Greek *patois* departed still more from the purity of the written language — which took refuge at court, in the tribunals of justice, and the halls of instruction — when the Frank crusaders augmented it by their own peculiar expressions, and the barbarians in the neighborhood engrafted theirs also upon it. This popular dialect first appears as a complete written language in the chronicles of Simon Sethos, in 1070–80. After the Ottomans had become masters of the country all the institutions which had contributed to preserve a better idiom perished at once. The people, left to themselves, oppressed by the most brutal despotism, would finally have abandoned their own dialect, which became constantly more corrupt, had not the Greeks possessed a sort of rallying-point in their Church. But even here, owing chiefly to the ignorance and corruption prevailing among the clergy, little could be found to prevent the further debasement of this fine dialect, which continued till the middle of the 18th century. About this time many of the Greeks began to resort for instruction to the universities of the West, whence they returned to their native country to animate their fellow-countrymen with the desire of making nearer approaches to the more civilized nations of Europe, so as not to remain behind in the general progress. One consequence of this was that the Greeks began to pay more attention to their mother tongue, and this tendency was increased by intercourse with the more refined West, by means of more frequent visits from intelligent men of that quarter to the ruins of Grecian greatness. The Patriarch (Samuel Eugene Bulgars Theotokos) of Corfu, and the unfortunate Rhigas, may be mentioned as eminent at this period.

At first a large part of the literature of awakened Greece consisted of translations from the French, but the country now furnishes original writers in every department of literature. Among the theological works of modern Greece perhaps the most remarkable is that on 'Truth,' by Pharmakidis (1852), which is one of the most important works in the modern Greek language. The philosophical and mathematical sciences are all well represented. For these branches of knowledge much has been done by the University of Athens, many of the professors of which have published manuals (some of which have no inconsiderable scientific value) on the subjects on which they lecture. With the exception of poetry, history is perhaps the department which has attracted most writers in the modern Greek language. On this head the long and learned dissertations prefixed by Spiridion Zampelios to his 'Popular Songs of Greece' (Corfu 1852), and 'Studies on Constantinople' (1858), affording valuable and interesting materials for the history of Greece in the Middle Ages, deserve to be particularly mentioned. In the department of philology and scholarship Coray has performed important services by collecting a large mass of materials for acquiring a more thorough knowledge both of ancient and modern Greek; and after him Doukas, Darbaris, Asopios, and Rhangabe, ought to be noticed for their editions of the ancient classics with commentaries in modern Greek. At the head of the orators of the time of the struggle for independence stands Trikoupis, some of whose speeches were collected and published in 1829, and a second and enlarged edition of them in 1860. In the department of poetry a distinction must be made between that of the people and that of the cultivated classes. The former is represented chiefly in the songs of the Klephts and other songs dating from the war of independence, which are a faithful mirror of the public life at the time to which they belong. At this period the war-songs of Rhigas were caught up by the whole nation and sung with enthusiasm. At a later period the two Soutsos, Panagios and Alexander, Calvos, Solomos, and others, earned distinction in the same kind of poetry. The Soutsos were distinguished also as dramatists and novelists, and Alexander also as a satirist. Among the other leading dramatists are Rizos Neroulos and Zampelios. The most distinguished recent author, both a poet and a scholar, is A. R. Rangabé, while Demetrius Bikelas is the chief novelist.

Modern Greek, as spoken by the uneducated classes, is called Romaic, from the fact that it took on its special character at the time when the Greeks considered themselves as natives of the Roman empire, and hence called themselves *Romaioi*, or Romans. The Greek of the educated classes, that used in the newspapers and other literature of the present day, is distinguished from it by a greater resemblance to the Greek of antiquity, which renders it easy for any one who has a satisfactory acquaintance with ancient Greek to read the literary Greek of the present day. The domain of the Romaic comprises not only the whole of the present kingdom of Greece (including Thessaly), but also part of Roumelia, Albania, and Anatolia, the islands of Crete and Cyprus, as well as the islands of the archipelago not belonging to Greece. The purest Romaic is spoken in the

less frequented isles of the archipelago, and in some of the mountainous districts of the interior. It is in these districts particularly that modes of expression are still found belonging to the most classical antiquity. At Megara the language is less corrupt than at Athens, where it is mixed with a considerable number of Italian words. In the northern provinces it is mixed chiefly with Albanian. Besides the foreign words which have been introduced into northern Greek, a pretty large number of words are found which have changed their original signification although they have retained their original form. Ancient words are most commonly found in significations the most remote from the original or derivative sense. The grammar has also undergone considerable modifications. For example, the numbers have been reduced to two by the suppression of the dual; and the cases to four, by the disappearance of the dative, the signification of which is now expressed by means of a preposition with the accusative. The first of the cardinal numerals is now used as an indefinite article. The degrees of comparison are sometimes expressed by the ancient inflexions, but at other times by the use of *pleon* (more). The past tenses of the verb are formed by the aid of the verb *echō* (I have), and the future tenses by the aid of *thelō* (I will). The infinitive mood, which has fallen out of use, has its place supplied by a periphrasis, in which the verb is put in the subjunctive. The middle voice has disappeared, and what remains of the old conjugation is of so little consequence that it may be regarded as an irregularity. The ancient orthography of the language is still preserved, but considerable changes appear to have taken place in the pronunciation. The vowels η, ι, and υ, and the diphthongs ει, οι, and υι, are all pronounced like *ea* in the English word *mean*. Β is now pronounced as *v*, and the sound of *b* is expressed by μπ. Δ is pronounced like *th* in *thus*, and θ like *th* in *think*.

Consult: Néroulos, 'Cours de Littérature Grecque Moderne' (1828); Rangabé, 'Histoire Littéraire de la Grèce Moderne' (1877); Nicolai, 'Geschichte neugriechischer Litteratur' (1876).

Greek Architecture. *First*, that which has existed in Greece, that is the land of the Hellenes, which, for art purposes, includes everything south of Mount Olympus on the east coast and the Island of Corfu on the west. This architecture is of several very distinct epochs. *Second*, the architecture identified with the Greek spirit at the time of the highest intellectual development of the race — viz. from about 500 B.C. to the Roman Conquest; and which is in architecture represented by the famous styles called Doric and Ionic, with the Corinthian just appearing at the time when the freedom of Greece was at an end. Each of these definitions of the term requires separate treatment.

First.— The architecture of the land of Greece is known to us in its earliest form by certain tombal chambers, in which a circular or polygonal room is enclosed and roofed with stone by one operation, that is, by laying the stones in courses continually projecting inwards, and so decreasing the size of the chamber within, until at last a single cap-stone closes the aperture at the top. These stone structures had passages leading to them, enclosed and roofed with stone; and these passages allowed of the covering in of the whole stone edifice with earth, perhaps in huge, high mounds. In this way, as in northern Europe and also in the peninsula of India, a great funereal monument was erected which cost nothing but the labor of transporting many thousand tons of earth and rough stone in addition to the comparatively slight building of the stone chamber and passage. The largest of these is among the ruins of Mycenæ, and has been known for many years as the Treasury of Atreus. More elaborate buildings are of what is known as the Mycenæan epoch (see MYCENÆAN) which is not accurately fixed, but which it is customary now (1904) to place at about 1700 B.C., lasting perhaps for 500 years. The name Mycenæan comes from the city of Mycenæ, explored first by Dr. Schilemann in 1876. We know only its remains, painting upon walls, inlays of metal, pottery and the like, and something is known of the plan of the royal palace and its accessory buildings; but no part of this enables us to fix the date. If we assume that this artistic civilization lasted until about 1200 B.C. there is less a lapse of time before the Homeric conditions began; for the palaces and fortresses described in the Iliad are generally accepted as of about 1,000 B.C. Again a blank occurs, and the earliest buildings of the Proto-Doric may be thought to begin about 600 B.C.

For the classical art of Greece, that is the building of the celebrated and beautiful temples, see the second part of this paper. This classical epoch lasts until the Roman conquest, and even beyond it in a modified form. Thus the gateway of the Agora in Athens is Doric of a style not used until the Roman control had begun; and it is extremely curious to compare this with the Doric of 500 years earlier. The Roman governors and generals built memorial buildings, porticoes and temples in a curiously modified style, partly pure Greek, partly of that Romanized Greek which was beginning to be recognized as the Imperial art for the whole Mediterranean world. Under the reign of Hadrian an attempt was made to return to a purer taste, but this was of brief duration. Greece was not to have an art of her own again until the Byzantine style was well established (see ARCHITECTURE and BYZANTINE ARCHITECTURE). The Byzantine style in the land of Greece was singularly characterized by very small proportions; there has never been an interesting style of which the monuments are so diminutive; important churches exist in Athens and other cities which would not hold two hundred persons and which are delicately built in a refined shape, and prettily if not richly decorated. The architecture of modern times in Greece is not more intelligent than that of the rest of Europe, while it is very simple and inexpensive. The country is small and poor, and even a royal palace cannot have much costly treatment; moreover the buildings in Athens are mostly of German design, according to the taste of the first dynasty established there after the freeing of Greece in 1823.

Second.— Grecian architecture in the sense of the classical style begins with what we call the Proto-Doric style as exemplified by the temple at Corinth, a building with low, thick columns and a comparatively high entablature, as far as can be ascertained. It is thought by some that the Heraion (that is the temple of Hera) at Olympia, is a still older building, and in that

case the earliest piece of classical Greek architecture. It is curious in form, as it has six columns at each end with sixteen on each side, the corner columns being counted twice, that is to say, there are forty columns in all. The peculiarity of this will be seen when we speak below of the perfected type of Doric temples. In the Olympia building the columns are of different sizes, varying even more than a foot in their thickness, and the capitals also differ. The common explanation, that the columns were originally of wood and were replaced by stone, one at a time, at all events points to the extreme irregularity of the structure. The Doric buildings of accepted and permanent type may thus be thought to appear first at the beginning of the 5th century B.C. The Greek colonies in southern Italy and Sicily were flourishing at this time and we find some of the earliest Doric temples of classical form in Pesto (the Roman Paestum, the Greek Poseidonia), in Campania and in Selinunte and Girgenti in Sicily. The style rapidly took definite form and was reduced at an early date to a very definite set of rules. Thus it became a recognized arrangement that the columns on the flank of the peristylar temple should be twice as many as those on the front and one more: the corner column being always counted twice. Thus the hexastyle temples at Athens, in Pesto and elsewhere, having 6 columns in front, have 13 on the side; and the only two octostyle Doric temples known — the Parthenon at Athens and the great temple at Selinunte — have 17 columns on the side. But all temples were not peristylar; on the contrary by far the greater number had porticoes only at the east front or at the east and west end. The essential parts of the temple are, of course, the closed naos or, as the Romans called it, the cella, in which the statue of the divinity was preserved, together with certain treasures, consecrated gifts and the like. There must have been thousands of these little shrines in Greece, the Greek islands and the colonies. A somewhat larger temple would have a second chamber, the treasury (opisthodomos) at the rear or west end of the cella, and this would have its own portico. The Temple of Theseus (so called) at Athens seems to have had a single chamber and two porticoes, one at either end, these being deep and sheltered and affording place for certain sacred statues and the like. Larger temples, like the Temple of Zeus at Olympia, the Parthenon at Athens, and the one at Pesto, called the Temple of Neptune, have the interior of the cella divided into a nave and aisles by two rows of columns; but just what the connection was between these columns and the carrying of the roof is not rightly understood. Some archæologists associate them with the assumed arrangement for admitting daylight into the interior through the roof (see HYPÆTHRAL THEORY).

The style of design was this — the columns were thick in proportion to their height and tapered from bottom to top, but not as a cone tapers, for the diminution of thickness follows a decided and even visible curve which is called the entasis. These columns are channeled from top to bottom by grooves, usually twenty in number, each having an elliptical curve or nearly so and meeting one another at sharp arrises. These shafts carried capitals made of one or two blocks of stone but always in two architectural parts. The lower part is what is called the echinus. It is a circular slab of stone projecting all round as much as half the diameter of the shaft in the earliest examples, perhaps a quarter of that diameter in the later ones; and this projection is rounded in a very subtle way, becoming flat below near the shaft and rounding more rapidly above. The curve of some of these echinus capitals is of extraordinary beauty. The uppermost member of the capital is a thick square block, or die, or plinth, sharp-cornered, without ornament of any sort except for the painting. These columns carry the epistyle or architrave, which, in the Doric style, is usually plain. Upon this rests what is known as the frieze, which consists of a series of upright blocks of stone perhaps half as high again as they are wide, and their height increased in appearance by grooves running vertically. These triglyphs carry, or seem to carry, the third or crowning member, the cornice, but between the triglyphs are the spaces called metopes, which are commonly filled by slabs or blocks of stone, the outer surface of which was always a favorite place for ornamentation. The cornice projected very much beyond the frieze, and its under side was cut with a drip moulding so that rain-water would not back up and run down the entablature, that being the name given to the three parts taken together, that is, to the whole horizontal superstructure laid upon the columns. There was nothing above this cornice except at the two ends the rising gable which marks the slope of the roof (see PEDIMENT), and on the side a gutter for rain-water with spouts or scuppers in its outer space.

The building of the temple was in this way as simple as possible — square cornered, oblong, roofed with a simple gable-roof, without arches or windows or chimneys. Its decoration was largely in the extreme refinement of the parts. The proportion of height to width, the spacing of columns and their shape and character were helped out by an extraordinary system of curves by which a grace was added to the building which the eye could hardly follow in its cause or character, but which changed the whole aspect very greatly. Thus the entablature was cut with an upward curve toward the middle and in this way the whole building had a lighter aspect than if it had been strictly horizontal. The same upward curve was repeated in the stylobate or stone floor on which the columns stood. The columns themselves were curved in outline as above stated, and they were set so as to slope inward, the outer ones the most, this for the obvious purpose of making the building seem more solidly set upon its base. To the building so carefully designed there was often added a great deal of elaborate sculpture (see below) and, apparently in all cases, rich chromatic decoration. For this subject see POLYCHROMY; but it may be mentioned here that the modern world has no very clear notion of what was the effect of brilliant painting in red and blue, with gilded metal, applied to a marble building standing high upon a prominent rock in the heart of a town, the recognized centre of interest and the chief religious shrine. No living man has ever seen anything at all like that; and it is probable that no imagination can reproduce it in thought.

To the modern student, the Doric style as described above, is much the most important part of Grecian architecture; but to a Greek of the time of Alexander the Great the Ionic temples along the shore of Asia Minor would have seemed the more grand and costly, the more recent, and therefore the more identified with advanced civilization. Those great temples have disappeared with a strange completeness. While there are Doric temples nearly complete except for the roof — which has, of course, disappeared,— while there are many others of which large and most interesting remains exist, many columns standing erect and some parts of the superstructure,— there is almost nothing remaining in complete condition of all the great Ionic temples. It is on this account that the exquisite building on the Acropolis at Athens, the Erectheum, contains in itself almost all our modern notions of the style. Very near it on the Acropolis is the little square amphiprostyle temple, known as the Temple of Athenæ Nike, or as the Temple of the Wingless Victory, and this shrine may also be considered an unchanged Greek building, because, though it was entirely destroyed, the stones of it were found built into a Turkish fortification and the whole structure was piled up again by the engineers of the first European king of Greece, Otho of Bavaria, who reigned from 1832 to 1862.

We learn from these buildings what the style really was. The shafts of the columns are much more slender than those of the Doric style and are fluted with circular grooves which are separated from one another by narrow fillets instead of meeting at a sharp edge. There is a base composed of mouldings running around the column. The capital is very peculiar, having volutes or scrolls at either side so that each capital has a front and a back precisely alike, and two ends alike, differing from all other capitals in not being alike on at least four sides. The members of the entablature are the same as those of the Doric style, but there are important differences in them. Thus the epistyle, instead of being a plain smooth block, is divided into three parallel surfaces, each one slightly overhanging the one below; the frieze is continuous and not broken by triglyphs; the cornice is more richly sculptured. Figure sculpture is applied in a somewhat different way. Thus as the frieze has no triglyphs it may be carved continuously; and in the Erectheum the sculpture is in the form of statuettes in white marble secured to a gray marble ground. It is not quite decided whether this color effect was helped out by painting or gilding, and how far the other parts of the temple were painted in bright colors. Again in the famous temple of Artemis (Diana) at Ephesus, the lower part of the shafts of the columns was in some cases very richly sculptured. The term *columna cælata* is applied to one of these columns and in any one of them is found this unique device:— the base is rather unusually high and is divided up by many mouldings; beginning about four feet from the pavement is a circle of figures larger than life surrounding the lowermost of those blocks of marble which make up the shaft proper; the flutings then begin above the band of sculptured figures and stop beneath the capital in the usual way. Not all the columns were arranged in this way, apparently only about one fourth of the whole number. The ancient Temple of Artemis which existed before the later magnificent structure was built had the same singular arrangement of sculptured shafts. Near Ephesus there have been found some capitals in which the head and shoulders of a bull project on either side beyond the volutes of the capital; and on the Island of Delos there are capitals made up entirely, so far as their decorations are concerned, of the heads of bulls. In the Erectheum of Athens there is that wonderful Portico of the Maidens in which an entablature made up of peristyle and cornice alone, without frieze, is supported on the heads of six caryatides, that is, draped female statues. In the National Museum at Athens are some caryatides of another portico. In the Incantada, a ruined Greek building in Salonica, there is a row of caryatides high up in the wall. The pilasters are treated with capitals of a curious style of Asiatic sculpture in the temple of Miletus. If to this we add the extraordinary capitals which some few monuments possess, monuments which must be called Grecian, but which are quaint and barbaric in appearance and almost grotesque, it appears that the Ionic was not as disciplined a style as the Doric but was influenced by the highly decorative sense of the Asiatic peoples and allowed of great variety of decorative design.

The Corinthian style is so little known to us as of Greek invention and use that it is almost always considered as a Roman or at most a Greco-Roman style; but the unquestionably Greek building, the little choragic monument of Lysicrates in Athens is Corinthian and the equally unquestioned and much more splendid round building at Epidaurus, was absolutely Greek, of pure type, and possessed a Corinthian order; the capitals completely developed. The dates are approximately, of the Athens building, 335 B.C.; of the Tholos, about the middle of 4th century B.C. The Athenian monument stands tolerably complete. The round building at Epidaurus is ruined and the capitals much scattered, but a single capital was found in a cellar or a chamber built for that purpose, and evidently intended to preserve it as a pattern, and this is intact. It is also one of the most beautiful Corinthian capitals known to us. The style, however, is almost identified with Roman work and will be treated in connection with ROMAN IMPERIAL ARCHITECTURE.

RUSSELL STURGIS.

Greek Art. Modern students of Grecian archæology do not doubt that the Greeks of different epochs were as successful in painting of stately and religious subjects and of painting and drawing in a slighter and more popular way as they were in sculpture; but this is merely an inference. Absolutely nothing remains to us of Greek painting of high class. We can study the figures on Greek painted vases and notice their admirable disposition and the beautiful designs made of their combinations, and we can note the technical system followed, sometimes by drawing on the clay with a hard point, sometimes without that help and drawn evidently with the brush alone. The use of pigment, too, generally black but sometimes of other colors, can be perfectly understood; but this is all of the simplest character, nor can we draw any conclusions at all about the wall-paintings or panel-paintings

of the Greeks. In the houses of Pompeii there are many wall-paintings which seem to have had a non-Italian and probably Greek origin, and furthermore it is known that Pompeii was a town of Greek settlement and retained much Grecian influence even under the Roman Empire. Some portrait heads have been found in Egypt painted on panel (that is, thin boards) and these are certainly non-Egyptian; they may be assumed to be Greek, of the Alexandrian epoch. In these, however, there is no background, no added incident, which might guide us to a knowledge of Greek design in Graphic art. Finally, some paintings discovered in Rome, though belonging to houses of late date, are altogether Greek in design; and these may well be reduced copies, or imitations, of famous originals three hundred years earlier. None of these paintings are of great importance. None of them give us an exalted idea of the painting which stood for their original impulse. The statements made by ancient writers with regard to the paintings of their own time and those who were then famous as having belonged to earlier times, are of very little use, because we have no standard with which to compare their critical remarks, and furthermore because no one of the books remaining to us from antiquity seems to be the work of a man greatly interested in fine art. For this reason the paintings on the vases are worthy of the most minute examination. The earliest style in which the subjects represented are at all elaborate are of the undetermined epoch which we call the Mycenæan. Those vases are rich in patterns of scrolls, bands, zigzags and spots with, somewhat rarely, animal forms introduced in bands and (as in Crete and Cyprus) as a principal subject and covering a large part of the body of the vase. The painting is generally in brownish red on a dull yellow ground, which is the natural color of the clay. The famous Warrior Vase found at Mycenæ and now in the Central Museum at Athens and which we must suppose to date from 1000 B.C., has much of that grotesque indifference to form and perfect satisfaction with an indication of meaning which we associate with barbaric art in all ages: the human form is drawn without any comeliness or grace and without any success in getting control of gesture; but the purpose is clear, viz., the displaying of a procession of warriors wearing large helmets, carrying great shields of the curious kidney shape long afterward associated with certain Asiatic influences, and carrying spears in the right hand, which spears have sometimes two heads or what seem to be heads.

The paintings on pottery which are of the most interest are those of the period beginning about 600 B.C. and ending about 150 B.C. The earlier pieces are, of course, difficult to date even approximately. They represent warriors engaged in battle, the scene forming a broad band running around the vase; lions, bulls and stags arranged again in horizontal bands; figures draped in long garments, men as well as women carrying stringed instruments, weapons, baskets and the like; occasionally a scene which can be identified, as where Hercules brings the Erymanthian boar to show to his brother, king Eurystheus, or where Peleus is about to carry off Thetis from among her attendant nymphs; or they represent a feast, with men reclining on couches and others acting as attendants bringing pitchers and vases to fill the cup held by the reclining guest. The beautiful black glaze of the vases is used sometimes as the pigment for the figures and sometimes to work the background around the figures. These two styles are known as the black-on-red or black-figure style, the other as the red-on-black or red-figure style, and this latter style is known as the later of the two. There is still another form which is generally the latest of all. In this the black glaze is worked over the whole vase except for a panel or medallion or even a band around the vase, which is left in the red color of the pottery, and upon this the figures are painted in black. From the 5th century on the drawing is extremely vigorous and significant. It is grotesque sometimes, as where the muscles are given excessive prominence or where the attitude is exaggerated in the attempt to make it tell the story; but everywhere the drawing of the outline and the filling in with color shows singular mastery.

In a few cases the drawing itself is faultless; but in by far the greater number of cases, even of a good time, it is rather the evidently slight and swift work of a man familiar with nature and with the best traditions of art but not using his whole strength in the slight painting of the earthenware. The use of pigments other than the black glaze is not very frequent; but a red somewhat brighter than the color of the clay is used, also a kind of violet, more rarely a green, and in some cases gilding is applied — especially in late and very elaborate work. A small class of vases, identified with the city of Athens, has the body covered with a solid coat of white, upon which figures are painted in various bright colors; but this work is perishable.

In close connection with the drawing and painting applied to pottery is the engraved work on the backs of bronze mirrors, on pieces of armor, and on cists (*cistæ*). Even as in modern times some of the most elaborate and precious drawing is that of the engraver working on copper-plate (though he proposes to take prints on paper from his engraving), so the Grecian draughtsman put some of his finest work on those engravings meant for pure decoration. As we have no free drawing on paper or plaster or wood — nothing that shows how the Greek drew with a free hand — we can only reason backward from the firm and resolute setting down of lines drawn on the resistant material with the sharp point, and infer the vigor and daring of the more unfettered design.

Sculpture in its different forms is, after all, that which Greece has left us which is most important. We have the marble reliefs carved upon temples, tombs, and the walls of sacred enclosures, and also a great number of slabs which, when more than two or three feet in either dimension are generally tombstones, but which, when small, are frequently mere records carved upon a boundary stone or a memorial, or else a votive slab dedicated at the shrine of some divinity. In all of these the propriety and the freedom of design are wonderful and, in relief sculpture at least, the Greeks have set an example which has never been equalled since, neither in the actual beauty of the form nor in the intelligence shown in the composition. The

GREEK VASES

GRECIAN ART.

most wonderful of the low reliefs are those of the famous frieze which forms the crowning member of the wall of the Parthenon within the screen of columns, the wall of the naos or cella. The well-known fact that this whole composition was painted in bright colors changes at once our ideas as to its decorative effect as a part of the building, but modern students can form no correct idea of the appearance of elaborate sculptures painted in an artistical fashion because they have never seen anything of the kind. One special reason why the reliefs are peculiarly important to modern students is their undoubted originality. The sculptures found at Phigalia, at Halicarnassus, at Xanthos, and at Gjolbaschi in Asia Minor are the undoubted work of the 4th and 5th centuries, and moreover they were designed for the places in which we now find them. This is not so with statues and busts, for of all the great world of Grecian statuary only three or four undoubted originals of the first rank remain. The Hermes of Praxiteles was found as Pausanius saw it in the 2d century A.D.; the Winged Victory of Paionios also; and these two were found in the excavations at Olympia in Greece. Statues of somewhat less importance have been found in the islands of the Greek archipelago and in specially protected underground chambers in the mainland of Europe, and a number of splendid bronzes, were found in a single great country house at Herculaneum near Naples; but as a general thing it has to be settled by internal evidence whether the piece discovered is of unmingled Greek character or of a less simple and perfect later style. The statues of the pediments, however, those which once stood at either end of the Parthenon, the Temple of Zeus at Olympia, the great temple of Ægina, and those which seem to have been placed between the columns of the Nereid Monument at Xanthos, are almost as certainly of their apparent epoch as are the bas-reliefs of the same buildings. In this way we have a score of fairly complete marble statues, two or three bronze statues of the highest rank, and a dozen less important ones, a score of life-size busts, and many smaller bronzes, all of which are assuredly of the best time of Greek art. Our knowledge of this subject is greatly helped by the study of engraved gems and coins. The gems were used for seals, or set in finger rings worn hung by a string, and the materials used were, of course, very hard stones, such as chalcedony and sardonyx; though glass was used also, and some seals are engraved in gold. The figure engraved in intaglio can be seen as if in relief when the stone is transparent and is looked at from the back. But commonly the student takes a cast in plaster or wax and studies that relief together with the original hollow sculpture of the gem. The number of these gems in our public and private collections is very great, even if we consider only those of undoubted Grecian origin. The coins are, in art, of the same character as the gems, because they are struck from a die, which die has been engraved in the same way in which the intaglio in hard stone is engraved: that is, the artist in either case keeps in mind the future relief and carves his hollow or sunken design rather with a view to its utility as a die than as to its own appearance. Greek coins are the subject of much and careful study among modern students. Greek sculpture includes also the earthenware figurines which have been found in great number in the neighborhood of Smyrna, in Sicily and the other islands of the Mediterranean, and especially in the neighborhood of Tanagra in Greece.

The years since 1850 have been rich in books on the subject of Grecian archæology, which archæology is, in great measure, the study of the existing works of art; books on Grecian vase-painting, gems and coins are to be counted by scores and hundreds. The latest are generally the best to begin with. The student will find in them the best means of judging what earlier books he may need; and at the same time he will find the latest discoveries and the most mature opinions of archæologists. The same remark applies to the periodicals, of which there are many and very valuable, for indeed much of the comparative study of this subject has been carried on in the columns of German, French and English periodicals, often issued by learned societies.

RUSSELL STURGIS.

Greek Church, or Holy Oriental Orthodox Apostolic Church, that section of the Christian church dominant in Eastern Europe and Western Asia, especially in Turkey, Greece, Russia, and some parts of Austria. In the first ages of Christianity numerous churches were founded by the apostles and their successors in Greek-speaking countries; in Greece itself, in Syria, Egypt, Mesopotamia, Asia Minor, Thrace, and Macedonia. These were subsequently called Greek, in contradistinction to the churches in which the Latin tongue prevailed. The removal of the seat of empire by Constantine to Constantinople, and the subsequent separation of the eastern and western empires, afforded the opportunity for diversities of language, modes of thinking, and customs to manifest themselves, and added political causes to the grounds of separation. During the earliest period the chief seats of influence in the Eastern Church were Jerusalem, Antioch, and Alexandria, the seat of that mystical philosophy, by which the oriental church was distinguished. In 341, soon after the synod of Antioch, the rivalry between the Bishop of Rome and the Bishop of Constantinople began to assume importance, and before the year 400 differences of doctrine with respect to the procession of the Holy Spirit appeared. The Council of Chalcedon in 451 reaffirmed the "pre-eminence of honor" after Rome, which had been granted Constantinople by the Second General Council in 381, but also accorded to its bishop supremacy, not only over Thrace, but over Pontus and Asia. This canon, the famous 28th, Rome refused to confirm. The title of *Œcumenical Patriarch* was assumed by John, bishop of Constantinople, in 588, and in the following year the phrase 'Filioque' ('and the Son') was added by the Latins to the Nicene Creed (which now read 'proceeding from the father and the son'), an addition to which the Greek Church was opposed. In 648 Pope Theodore deposed Patriarch Paul II.; but a reconciliation of the churches was effected at the Council of Rome (680). The doctrines of the Greek Church were defined by John Damascenus in 730. The disruption was hastened by the banishment of Ignatius by Michael the Drunken, and the consecration of Photius (858). Pope Nicholas I. refused to sanction

the usurpation of Photius and excommunicated him. The schism was temporarily healed after the death of Photius, but Michael Cerularius reopened it by charging the Latins with heterodoxy. He was excommunicated by Leo IX. in 1054, since which the Greeks have been severed from the Roman communion, though the Russo-Greek Church was not separated until the 12th century. The presence of the Crusaders in the East aggravated the quarrel; Latin patriarchates were established in Antioch and Jerusalem, and, though on the capture of Constantinople by the Crusaders a Latin patriarchate was set up there (1204), the schism was revived there as soon as the Latin empire fell (1262). Reunion was proposed in 1273 by Patriarch Joseph, and effected, with the acknowledgment of the pope as primate, at the Council of Lyons (1274). The union, however, was annulled in 1282 by Emperor Andronicus II., and in 1283 and 1285 by synods of Constantinople. It was again effected under John Palæologus at Florence in 1439, but was repudiated in 1443 by the Patriarchs of Alexandria, Antioch, and Jerusalem. In 1453, when the patriarch fled from the Turks, a schismatic, Gregory Scholarius, was chosen in his place. In 1575 unsuccessful negotiations were commenced with a view to union with the Lutherans, and in 1723 the English bishops even proposed that the Greek and Anglican churches should unite, a proposal revived by the archbishop of Moscow in 1866. The claims of the czar in 1853 to the protectorate of the Greek churches in Turkey was one of the causes of the Crimean War.

The Greek Church is the only church which holds that the Holy Ghost proceeds from the Father only; the Roman Catholic and Protestant Churches deriving the Holy Ghost from the Father and the Son. Like the Roman Catholic Church it has seven sacraments — baptism; chrism; penance, preceded with confession; the eucharist; ordination; marriage; and unction. But it is peculiar (1), administering baptism by threefold immersion, the chrism (confirmation) following immediately after it; (2), in adopting, as to the eucharist, the doctrine of the real presence and transubstantiation; but in ordering the bread to be leavened, the wine to be mixed with water, and both elements to be distributed to every one, even to children; (3), the parochial clergy are required to be married, but only once and to a virgin, and marriage must take place before ordination; widowed clergy are not permitted to retain their livings, but go into a cloister, where they are called *hieromonachi.* Rarely is a widowed bishop allowed to preserve his diocese. The Greek Church grants divorce in case of proved adultery, but it does not allow even the laity a fourth marriage. It differs also from the Roman Catholic Church in anointing with the holy oil, not the dying but the sick, for the restoration of health, forgiveness, and sanctification. It rejects the doctrine of purgatory, works of supererogation, indulgences, and dispensations, but admits prayers for the dead, whose condition appears to be considered undetermined until the final judgment. It recognizes no visible vicar of Christ on earth, but the spiritual authority of patriarch is little inferior to that of the pope. It allows no carved, sculptured, or molten image of holy persons or subjects; but the representations of Christ (except in the crucifix), of Mary, and the saints, must be merely painted, and at most inlaid with precious stones. In the Russian churches, however, works of sculpture are found. In the invocation of the saints, and especially of the Virgin, the Greeks resemble the Latins. They also hold relics, graves, and crosses sacred; and crossing in the name of Jesus they consider as having a wonderful and blessed influence. Among the means of penance, fasts are particularly numerous with them. They fast Wednesday and Friday of every week, and besides observe four great annual fasts, namely forty days before Easter; from Whitsuntide to the days of Sts. Peter and Paul; the fast of the Virgin Mary, from the 1st to the 15th of August; and the apostle Philip's fast, from the 15th to the 26th of November; besides the day of the beheading of John the Baptist, and of the elevation of the cross. The calendar of the Greek Church is in the old style, their New Year's Day falling on 13 January.

The services of the Greek Church consist almost entirely in outward forms. Preaching and catechizing constitute the least part of it. Instrumental music is excluded altogether. The Mass is considered of the first importance. The convents conform, for the most part, to the strict rule of St. Basil. The Greek abbot is termed *hegumenos,* the abbess *hegumenē.* The abbot of a Greek convent which has several others under its inspection is termed *archimandrite,* and ranks next a bishop. The lower clergy in the Greek Church consist of readers, singers, deacons, etc., and of priests or popes and protopopes or archpriests, who are the first clergy in the cathedrals and metropolitan churches. The members of the lower clergy can rise no higher than protopopes, for the bishops are chosen from among the monks, and from the bishops are selected the archbishops, metropolitans, and patriarchs. In Russia there are twenty-four dioceses. With which of them the archiepiscopal dignity shall be united depends on the will of the emperor. The seats of the four metropolitans of the Russian Empire are St. Petersburg, Kiev, Kasan, and Tobolsk. In the Turkish dominions the dignities of Patriarch of Constantinople, Alexandria, Antioch, and Jerusalem still subsist. The Patriarch of Constantinople still possesses the ancient authority of his see; the other three patriarchs exercise a very limited jurisdiction, and live for the most part on the aid afforded them by the Patriarch of Constantinople.

The United Greek Churches comprise those Churches of Greek rite which are in communion with the See of Rome: the adherents of these Churches are commonly styled Uniates, and the Churches Uniate Churches. There are five such Uniate Greek Churches, namely, those of the Melchites, of the Ruthenians, of the Greek Catholics of Italy, of the Græco-Romaic rite, and of the Bulgarians. These several Churches retain their several Greek or Oriental liturgies and sacramental rites and most of the usages and ceremonies of the Eastern schismatical Churches from which they are sprung.

The Melchites represent those Churches of Syria and Egypt which, in 1686 and later, seceded from jurisdictions of the Monophysite patriarchs of Antioch, Jerusalem, and Alexandria. Their number is small, perhaps not exceeding 50,000 souls, but they have three patriarchs, with bishops subordinate to them.

The Ruthenian United Church is an offshoot of the Russian Greek Church by secession; the membership of this Church in Russian Poland and in the Austro-Hungary monarchy comprises probably 1,000,000 souls.

The United Greeks of Italy, mostly in Calabria, are estimated at 30,000.

The Græco-Romaic Church of Hungary and Transylvania has about 1,000,000 adherents.

The United Bulgarian Church dates from 1860, when several bishops with a considerable following of their people were received into the communion of the Church of Rome.

All these Churches retain the ancient Greek liturgies of the Eastern Churches from which they seceded, and to a great extent their ancient systems of discipline. The priest, as in the Greek orthodox and in the Russian orthodox Church, must be married, and the bishops must be celibates: hence the bishops are usually chosen from the monastic order. The widowed priest is not permitted to contract a second marriage. In short, these Churches retain, of the religious practices and of the discipline of the several Eastern Churches from which they seceded, whatever is not inconsistent with allegiance to the supreme pontiff in matters of doctrine.

The language of the Ruthenian United Church's liturgy is Old Sclavonic, and translated from one of the ancient Greek liturgies. The liturgy of the Melchites is that of St. John Chrysostom, and on certain occasions that of St. Basil, both in the original Greek. The liturgy of the Bulgarian Church is also of Greek origin, but translated into an ancient Sclavic idiom.

Greek Fire, a combustible composition made probably of naphtha, sulphur and nitre, which was first used in 673 A.D. by the Greeks of the Byzantine Empire against the Saracens. Its invention has usually been ascribed to Callinicus of Heliopolis, and to the year 668 A.D. The mixture appears to have been highly inflammable, and to have been difficult to extinguish; was poured out, burning, from ladles on besiegers, projected out of tubes to a distance, or shot from balistæ, burning on tow tied to arrows. At Constantinople the process of making Greek fire was kept a secret for several centuries; but the knowledge of its composition and the use of it, gradually spread to the West. It was in use for a short time after the invention of gunpowder. Combustibles of a similar kind were used at the siege of Charleston in 1863, composed of sulphur, nitre, and lampblack: and naphtha in shells was also tried.

Greek-letter Societies, or **College Fraternities**, are found in nearly all leading educational institutions, particularly the great universities, in the United States. Branches of the various societies are known as "chapters," and are found in nearly every college as well as in every large city in the country. No society has more than one chapter in any one college. While these societies are secret in character there is neither ritual nor mystery in their conduct, the protection of meetings, constitution and mottoes being all the secrecy involved. The Greek alphabet is generally used in naming a fraternity, or a chapter. There are three types of badges worn by members, the name badge, monogram badge, and symbol badge. In the latter a key, skull, or scroll is usually employed.

The oldest of these literary and social brotherhoods was established as early as 1776, and continued the sole society of its kind for 50 years. There were in 1902 more than 800 chapters of these societies in American colleges, with a membership including the alumni, of more than 100,000. It has become quite the practice for students of a particular fraternity to reside together during their college course in their "chapter" house. In 1901 there were 70 such houses in the United States owned by the "chapters," and 200 other houses rented by them. Princeton is the only prominent college in the country where the fraternal society is prohibited, and the fact that all the other leading institutions permit these organizations to exist affords strong presumption that they are regarded with favor, and that their influence is for good rather than for evil. In 1902 there were 25 of these societies for men and 8 for women, in the universities and colleges of the United States.

Phi Beta Kappa.— This, the oldest organization, is composed of 53 college chapters, and was founded 5 Dec. 1776, at William and Mary College, Williamsburg, Va. A chapter was formed at Yale, in New Haven, in Dec. 1779, and soon after at Harvard, Dartmouth, Bowdoin and Amherst. The society in 1902 had a membership of 11,000. The national council meets triennially. The badge of the society is a golden key. Among prominent members are T. W. Higginson, Seth Low, Joseph H. Choate, and H. W. Mabie.

Kappa Alpha.— Founded in 1825 at Old Union College by four members of the Phi Delta Kappa. It likewise had a golden key as a badge design. The first branch of this society was established at Williams College. The society had 1,000 members in 1902, prominent among them being Wheeler H. Peckham, John Boyd Thatcher, L. Clark Seelye, and Edward S. Bragg.

Sigma Phi.— Founded at Union College, Schenectady, N. Y., 4 March 1827, the society established branches at Hamilton, Williams, Hobart, Lehigh, Cornell and the Universities of Michigan and Vermont. It had a membership of 1,400 in 1902. The badge of the society is of the monogram type; the colors are light blue and white. Among its members are Elihu Root, Andrew D. White, and John H. Post.

Delta Phi.— Founded at Union College, 17 Nov. 1827, this society established branches at Columbia, Rutgers, Harvard, Johns Hopkins, Cornell, and other colleges. The badge is in the form of a Maltese cross; colors blue and white. There are several thousand members, among them John Jacob Astor, Ernest Howard Crosby, and R. O. Doremus.

Alpha Delta Phi.— Founded at Hamilton College, Clinton, N. Y., in 1832, the society established chapters in 10 other colleges and had a membership of 8,400 in 1902. There are 16 houses owned by the society and 24 active chapters. The badge is of green and white, with the star and cresent as symbols. Among prominent members are W. R. Day, Bartow S. Weeks, Henry Clews, Jr., Jas. K. Hackett, and H. E. Lippincott.

Psi Upsilon.— Founded at Union College, 24 Nov. 1833, this society had 4 of its original founders still living in 1902. The membership of the organization is over 10,000, with 22 chapters in various colleges. The badge is of gold, dia-

mond-shaped; colors garnet and gold. Among its members are Chauncey M. Depew, Wm. C. Whitney, G. R. Schieffelin, and Herbert L. Bridgeman.

Delta Upsilon.— Founded at Williams College in 1834, the society has chapters in 34 colleges and universities, with a membership of 8,000. It is an open, non-secret organization and owns 24 chapter houses. Among its prominent members are David Starr Jordan, Rossiter Johnson, W. H. P. Faunce, and Rev. Charles M. Sheldon.

Beta Theta Pi.— Founded at Miami University, Oxford, Ohio, in 1839, this was the pioneer society of the Middle West. It has a membership of 12,500, with 54 active chapters. The badge is a shield with 8 sides curved inward; the colors are light pink and blue. Among its prominent members are Foster L. Backus, Paul Wilcox, and W. R. Baird.

Chi Psi.— Founded at Union College, in 1841, this was the first Eastern society to establish chapters in the West, extending its organization to the Universities of Michigan and Minnesota. It had a membership in 1902 of 4,500 with 19 active chapters. The chapter house at Cornell is the finest fraternity house in this country. The society is more secret than most of its fellows. The badge is a jeweled monogram. Among its members are Willis J. Abbot, Francis M. Scott, and Allan Lee Smidt.

Delta Kappa Epsilon.— Founded at Yale College, New Haven, Conn., 22 June 1844, by 15 members of the junior class. The society has established 48 chapters and had a membership in 1902 of 13,548, being the strongest numerically of any college fraternity. Among prominent members of the society are President Roosevelt, John D. Long, Whitelaw Reid, Howard Gould, Julian Hawthorne, Cyrus C. Adams, John DeWitt Warner, M. G. Hyde, Julius Chambers, and G. R. Hawes.

Zeta Psi.— Founded at the New York University, 1 June 1847, this society established 21 chapters, and had a membership in 1902 of 5,330. The badge is a monogram; the color white, with which each chapter blends its college colors. Among prominent members are Augustus Van Wyck, Wm. Shrady, Harrison Grey Fiske, and H. W. Bookstaver.

Delta Psi.— Founded at Columbia College, New York, in Jan. 1847, has 11 chapters and a membership of 3,000. The badge of the society is a St. Anthony cross, bearing a shield of blue enamel. Among its prominent members are Thomas Nelson Page, W. Seward Webb, F. W. Vanderbilt, Brander Matthews, Wm. E. Curtis, and D. S. Appleton.

Theta Delta Chi.— Founded like several of its predecessors at Union College, this society was organized in 1848, and has 22 chapters and 4,000 members. The badge is a monogram; the colors black, white and blue. Among its members are John Hay, J. W. Griggs, H. H. Hanna, S. Fred Nixon, and Rev. David Gregg.

Phi Gamma Delta.— Founded at Jefferson College, Canonsburg, Pa., in May 1848, this society has established 57 chapters and has a membership of 8,753. The badge is a diamond-shaped shield on a field of black, bound by a golden cord; the color royal purple. Among its members are Gen. Lew Wallace, Edward Eggleston, S. S. McClure, Leigh H. Hunt, and R. Lloyd Jones.

Phi Delta Theta.— Founded at Miami University, Oxford, Ohio, 26 Dec. 1848, this society has established 68 chapters and has a membership of 12,000. The badge is a shield, bearing a scroll; the fraternity colors are argent and azure. Among its members are C. P. Bassett, Irving R. Bacon, C. P. Van Alen, and Rev. E. A. Dent.

Phi Kappa Sigma.— Founded at the University of Pennsylvania, 16 Aug. 1850, has established 15 chapters and has a membership of 1,000. The badge is a gold Maltese cross, with a skull and crossbone centre; the colors are old gold and black. Its membership includes H. C. King, J. R. Paxton, M. J. Asch, Geo. G. Battle, and Wm. McClure.

Phi Kappa Psi.— Founded at Jefferson College, Canonsburg, Pa., 19 Feb. 1852, has established 40 chapters and had, in 1902, over 8,000 members. The badge is a shield of gold; the colors pink and lavender. Prominent among its members are Henry T. Scudder, F. E. Hamlin, W. L. Stoddard and Thos. A. Nelson.

Chi Pi.— Founded at Hobart College, in Dec. 1854, has organized 19 chapters with a membership of 4,700. The fraternity was reorganized in 1896. The badge is a monogram. Geo. S. Hobart, H. C. Platt, F. A. Mandeville, and F. C. Weber are among its prominent members.

Sigma Chi.— Founded at Miami University, Oxford, Ohio, 20 June 1855, has organized 50 chapters and has 8,000 members. The badge is a cross of gold and white enamel; the colors are blue and gold. Among its members are Thos. Ewing, Jr., Wm. E. Quimby, H. W. Chatfield, and Henry A. Potter.

Sigma Alpha Epsilon.— Founded at the University of Alabama in 1856, has organized 59 chapters and has 7,000 members. Among its prominent members are Charles B. Harvey, F. K. Knowlton, T. W. Beach, and H. P. Nash.

Delta Tau Delta.— Founded at Bethany College in 1860, has organized 37 chapters and has a membership of 1,200. The colors are purple, gold and white.

Alpha Tau Omega.— Founded at the Virginia Military Institute, 11 Sept. 1865, has organized 45 chapters and has a membership of 6,000. Among its prominent members are Irving Bacheller, Hugh S. Thompson, E. B. Southworth and Walter H. Page.

Kappa Sigma.— Founded at the University of Virginia in 1867, has established 49 chapters and has a membership of 3,500. The badge is a crescent and star; the colors old gold, maroon and blue.

Sigma Nu.— Founded at the Virginia Military Institute, 1 Jan. 1869, has organized 46 chapters and has a membership of 5,000. The badge is designed after that of the Legion of Honor of France; the colors are black, white and gold.

Phi Sigma Kappa.— Founded at the Massachusetts Agricultural College, 15 March 1873, has organized 14 chapters and has a membership of 1,050. The colors of the society are silver and magenta. Among its members are Wm. H. Bishop, S. C. Thompson, J. W. Goff, Jr., and M. C. Valentine.

Among the Greek-letter Societies of women are the Alpha Chi Omega, Alpha Phi, Chi Omega, Delta Delta Delta, Delta Gamma, Kappa Alpha Theta, Kappa Kappa Gamma, and Pi Beta Phi. The Alpha Phi was founded in 1872, has 10 chapters and 1,100 members. The Delta Delta

Delta was founded in 1888, has 17 chapters and a membership of 1,000.

In October 1903 there was organized at the Indiana University the first negro Greek-letter society in the United States. It is known as the Alpha Kappa, with a charter membership of 10.

Greek Music, the theory and practice of melody and harmonics among the ancient inhabitants of Hellas. The subject of Greek music is an obscure and difficult one, but there are enough data extant to afford us a general idea of the Greek musical scale, of the use of instruments, and employment of the voice in solo and chorus among the Greeks. The earliest notion of music was derived from the necessity of keeping time in the dance. This at first would be effected by merely clapping the hands. The use of instruments of percussion would follow, and the drum and cymbal came into use. The cymbal originated in Egypt, and reached Greece as a permanent element in the practice of music. The rustle of the wind through the reeds, sometimes with a shrill whistling vibration, suggested the application of the human breath to hollow pipes, and what is still called the Pan's pipes was invented. Wind instruments of various kinds came afterwards into vogue, the flute, and the double flute were employed, and seem generally to have been blown as accompaniments to the elegy and the love song. These pipes were of various kinds and were considered as good accompaniments to the recitations of the poet, as well as for regulation of movement in a dance. They were employed in the ceremonies of the mysteries, and Plato speaks of an often recurring thought as resembling "the sound of the flute in the ear of the mystic."

Instrumental music attained its highest development in the invention of the lyre. The Egyptians attributed this invention to their god Thoth. In Greece Hermes is celebrated as the inventor of the lyre, which became henceforth the instrument of the epic poet and the rhapsode or reciter. It had originally four strings, which it is said were suggested by the tendons stretched over the shell of a tortoise. The first Greek philosopher to attempt a scientific theory of musical scales and intervals appears to have been that profound and versatile man Pythagoras (585 B.C.). The Greeks did not use the word music in application to the art which we so name. Music to them comprised everything which the Muses inspired, and even history and astronomy as well as poetry were music. What we mean by the term was called by the Greeks harmonics, which means the art of fitting, that is, adjusting the intervals in a scale, in the strings of a lyre. The scale of Pythagoras had seven notes, corresponding with the seven strings of his lyre, and he professed to derive his idea of music from the music of the spheres. The sun revolving round the earth was to him the chief planet, and was represented by the middle string of the lyre which was considered the key-note, corresponding with A in the modern scale. On one side were strings representing Mercury, Venus and the Moon, on the other side three more corresponding with Mars, Jupiter and Saturn. It is said that Pythagoras discovered the ratios of the perfect intervals from hearing blacksmiths striking an anvil with hammers of different weights. Aristoxenus (B.C. 300) discovered the difference between the major and minor tones and has been called "the father of temperament." Claudius Ptolemy (B.C. 150) demonstrated the musical axiom which obtains in modern times that the major tone should be below the minor.

The Greeks had four modes or scales, the Dorian, the Phrygian, the Lydian, and the Mito-Lydian. The Dorian was set in the key of F natural, and the rest were distinguished by analogous differences.

The ancient Greeks were passionately fond of music, and elaborate treatises were written by them on the science and art. They did not understand harmony, and Aristotle (384 B.C.) speaks of the only chorus singing known as that of men singing a melody an eighth lower than it was sung by boys, which of course would be unison. Music was employed at Athens by wandering epic minstrels; it was also common in religious ceremonies, and to regulate the movements of the army. It formed part of the drama. We are told that Æschylus, the father of tragedy, composed the music for his own dramas and that Sophocles accompanied on the lyre the performance of one of his plays.

Greek Philosophy, the various speculations of the ancient Greeks with regard to the origin of things. This is but a partial description of the intellectual efforts made by the keen and powerful minds of the ancient world to solve those problems which science now-a-days is so eagerly investigating. The origin of Greek philosophy was the gradual disbelief that had seized men's minds as to the truth of the ancient poetical cosmogonies, and antique mythologies of religion. Faith was dead and reason had awakened. In the 7th century before our era, in the flourishing city of Miletus, capital of the Ionian colony, the first Greek philosopher propounded the question which is still being put, What is the basic substratum of all phenomena? In our own days Huxley called it protoplasm; Herbert Spencer said it was force. Thales of Miletus (636 B.C.) declared it was water, which to him seemed to permeate and give life to all things. Thales was the first of the Greek physicists, or materialists, and was considered one of the Seven Wise Men of Greece. He was the founder of the Ionian School of Philosophy. He was succeeded in the long line of philosophical inquirers by Anaximenes (529 B.C.): who looking for the first element, the first cause, found it in air. Air was universal and must be the parent of all things. It was the breath of life and must therefore be the source of it. Diogenes of Apollonia (460 B.C.) fixed upon a higher notion as the first cause of things. He saw the ruling race of mankind prevailed over nature by their intelligence. He decided that intelligence was the cause and foundation of all things. In these speculations as to the nature of the universe and its origin we come upon two remarkable men, Anaximander of Miletus (610 B.C.) and Pythagoras, who invented the word philosophy. The former taught that all existence came from the infinite — a vague term, which did not mean the infinite intelligence but the infinite existence. Pythagoras said that number was the first thing, from which all else proceeded — a metaphysical abstraction, which almost defies analysis. Aristotle says the Pythagoreans "taught that number was the beginning of things, the cause of their mate-

rial existence, and of their modifications and different states."

The school of Eleatics is chiefly represented by the poet Xenophanes (620 B.C.). His philosophic creed is thus described by Aristotle: "Casting his eyes upward at the immensity of heaven, he declared that *The One* was God." Reason and imagination led this thinker to become at once a Monotheist and a Pantheist. Parmenides who was born (536 B.C.) at Elea, a city which gave its name to Eleatics, was the first to make the great distinction between truth and opinion, between the deductions of reason and the impressions of sense. He made being the basis of things, for non-being was impossible — a discovery which at that stage in philosophical speculation was of great importance. Zeno, another Eleatic, b. 500 B.C., who was the inventor of logic, was persecuted and put to death for free-thinking, and was a follower and disciple of Parmenides. Plato says that the master proved the existence of the one; the disciple established the non-existence of the many. He preserved his master's distinction between truth and opinion. "Your senses," he would say, "tell you that there are many things existing; reason avers that there is but one."

A contemporary of Zeno was a man who began at Ephesus those speculations as to the origin of the universe to which as preliminary he added a theory on the origin of knowledge. This was Heraclitus (503 B.C.). He was a disciple of Xenophanes, and taught that fire is the origin of everything, and there is no existence, but only change; things cannot be said to be, but only to be becoming; processes and not states formed the mode of existence. We cannot know or name anything with truth, for as we look at it, it changes, and is something different from what we thought it.

Anaxagoras came from Clazomenæ to Athens just when the age of Pericles was dawning; he had indeed Pericles, Euripides, and Socrates as his pupils. He attacked the patriotic religion of the proud city and was banished to Lampsacus. He thought that all sense — knowledge — was delusive until corrected by reason. He believed that intelligence was the creative and regulating influence of the universe. Things as they are were brought about by the concourse of infinite atoms; but these atoms were of all sorts, and that like was united to like in an infinite series of movement and combination; gold by the union of gold atoms that had existed from eternity, fires from fire atoms, air from atoms of air. These atoms were the famous homœomeriæ spoken of and condemned by Aristotle. Empedocles (444 B.C.) was of the great city of Agrigentum; in his views of knowledge he belonged to the Eleatics, and maintained that the senses were fallible, while reason was a sure guide to truth. He was a poet and declaimed against anthropomorphic ideas of deity. He gathered in one the doctrines of the Ionian physicists declaring the primary elements were four, namely, earth, air, fire and water. Love was the formative principle of things, hate the dissolver and destroyer. One was harmony, the other discord, and God is the One, "a sphere fixed in the bosom of harmony, rejoicing in calm rest."

Democritus of Abdera (460 B.C.) was a rich man who entertained Xerxes at his house. He went one step further than Anaxagoras, and almost entered the circle of our modern science by teaching the atomic theory, namely that everything in the world is the result of a fortuitous concourse of atoms, all of the same substance, but making various things through the various forms they take in uniting. Color, sweetness, cold, are the result not of substances essentially differing; all is form.

All attempts had so far failed to solve the problems of the material world, and of human knowledge. Many theories were put forth, none were universally accepted, although they were each discussed. This brought the Sophists on to the stage of philosophy — men who taught the arts of discussion, not of investigation. One of the greatest of them was Protagoras. He was a disciple of Democritus, and taught that opinion was everything, "Man, the individual man, each for himself, is the measure of all things." The Sophists were the first skeptics, but a new epoch rose with Socrates (469 B.C.). He was the most remarkable man in all the Greek world; for his love of disputation he was classed by some with the Sophists, for his ridicule of traditional views in religion and physics, he was condemned to death — yet he succeeded in substituting morals for physics as the subject of philosophy. He first gave to philosophical methods the definition and the inductive argument, or reasoning by analogy. One of his disciples, Aristippus of Cyrene, while he followed the method of his master, founded the Cyrenaic school which taught that pleasure was the criterion of the true: Socrates had taught that the good as judged by the individual conscience was that criterion. Then followed the Cynics, under Antisthenes, who went to the opposite extreme to Aristippus, became an ostentatious ascetic, and in this was followed by Diogenes of Sinope, who made his home in a cask or tun, and tried to set the example of a rugged virtue, which is misanthropic, but triumphant over bodily appetite. It was left to Plato to exhibit the complete adoption and application of the Socratic method. He believed that in each man resided the power of detecting the truth, from having seen the perfection of things, in an ideal world during a previous state of existence; he could judge of the good and the beautiful here from his memory of what their perfect archetypes were. His voluminous writings enable us to judge both of his ethical and political system, but they both fail in practicality. His most famous pupil was Aristotle (384 B.C.), a man of encyclopedic mind, the first scientific observer, the inventor of the syllogism. Plato was an idealist and a rationalist; Aristotle a materialist and an empiric. The one trusted to reason, the other to experience. Aristotle always argued against the ideal theory of his master, and deduced his conclusions from things as he saw them. He invented grammar as well as logic, and was in himself an epitome of the philosophic learning of his predecessors. But by reasoning from experience he had opened the way for the skeptics, of whom the first was Pyrrho, who taught that there is no criterion of truth. Phenomena are mere appearances, how can we prove they are anything else? This was what in modern times is called agnosticism, for we cannot prove and therefore cannot know the truth of anything we see. But after this suicide of philosophy in the school of Pyrrho, she revived again as a moral mentor in the person of Epi-

curus, of Samos (342 B.C.). He taught the highest good is pleasure; this is the moral end of existence. He was controverted by the Stoics. Zeno was their leader, a man of stern unbending character and abstemious life, whose aim was to show that virtue consisted in manhood, and manhood in the power to endure hardness and to despise the body. Skepticism, indifference, sensuality and epicurean softness were not to be combated by the vague dreams of Plato, or the cumbrous system of Aristotle. The Stoic attempted to meet the growing decadence by an exactly opposite self-denial and impassive reserve. But Stoicism was egotistic; its aim was the repression of feeling, it was apathy, death in life. The last struggle of Greek philosophy to dominate the mind of society was witnessed in the rise of the New Platonists and their New Academy. Carneades (213 B.C.) was their most illustrious representative, and he was the type of a school that took up the doctrines of Plato, expanded and enlarged them until the time when Christianity appeared, and faith, not reason, as in the old days seven hundred years before, dominated the world of opinion. See PHILOSOPHY, HISTORY OF.

Greek Theatre, First in America, the gift of William R. Hearst to the University of California, is exactly similar in its proportions to the famous theatre of Dionysus at Athens.

The structure was used for the first time at the University of California commencement 1903 when President Roosevelt was the orator of the day. It was then learned that every one of the 8,000 spectators seated in the theatre could hear with perfect distinctness.

No roof shuts out the sunlight or starlight from the audience. Situated right in the heart of magnificent scenery, tall trees towering up above the walls on all sides and the building itself being an architectural gem, it will readily be seen that very little stage scenery will be needed when presenting the early plays which will be given by university students and the leading actors of the world as soon as all is ready.

The entire structure is white; the hangings will be a blending of the Greek and Roman colors; but there will be very few decorations used aside from architectural carvings, the splendor of the place being in its dimensions and simplicity.

Though this theatre is modeled in a general way after the ancient classic buildings of a similar character, no single historic example has been literally followed. The theatre at Epidaurus, in Greece, however, offers many points of similarity, notably in the difference of slope between the upper tiers of seats and the inner and lower portions of the auditorium. The new theatre is of approximately the same size as the larger theatre at Pompeii.

The building is, as a whole, made up of two separate and distinct parts, namely, the stage, corresponding to the ancient logeion, and the auditorium.

The floor of the stage is 133 feet wide and 28 feet deep. It is entirely open toward the auditorium and surrounded on the other three sides by a wall 42 feet in height. This wall, which corresponds with the ancient skene, is enriched by a complete classic order of Greek Doric columns with stylobate and entablature, the ends of the side walls toward the auditorium forming two massive pylons. Five openings pierce the wall, the entrance in the centre of the back of the stage being the most important — the so-called royal door of the ancients. This is flanked by two minor doors to the right and left, the two remaining openings occurring on the return walls at either end of the stage.

The auditorium or theatre proper is semicircular in form, 254 feet in diameter, and is divided into two concentric series or tiers of seats. The first series is arranged about a level circle 50 feet in diameter and 5½ feet below the stage, which corresponds to the space anciently devoted to the chorus, orchestra, etc.

From this circle the receding rows of seats step up gradually until the stage level is reached at a circle corresponding in diameter with the terminal pylons of the stage wall. This line is marked architecturally by a passage, anciently named the diazoma or diodos, running around the semicircle of seats midway between the orchestra and the topmost circle. The diazoma is protected on its outer side by a wall, beyond which the seats step up more steeply, approximately at an angle of 30 degrees with the horizontal, to the outer limit of the theatre.

It is estimated that more than 7,000 persons can be seated in the theatre proper. The stage will accommodate some 600 more, a number which can be readily added to by the temporary extension of the stage floor toward the auditorium.

Greeley, Horace, American journalist: b. Amherst, N. H., 3 Feb. 1811; d. Pleasantville, N. Y., 29 Nov. 1872. More than 30 years after his death, Horace Greeley's name remains at the head of the roll of American journalists. Successors in the primacy of current discussion may surpass him, as doubtless some of them already have, in consistency and learning, but hardly in the chief essentials of a journalistic style; others may exert a more salutary influence, if not so personally diffused: but in the respect of high ideals, courage, intellectual force, and personal magnetism, the qualities which impel a man of letters to be also a man of action, Horace Greeley was of heroic mold. He was no pop-gun journalist firing from a sky-sanctum, but a face-to-face champion in the arena of public affairs, laying about him with pen and speech like an ancient Bayard with his sword. The battles he fought for humanity, and the blows he gave and received, have made him for all time the epic figure of the American press.

Born in rural New Hampshire, of English and Scotch-Irish descent, he epitomized his heritage and his attainment in the dedication of his autobiography "To our American boys, who, born in poverty, cradled in obscurity, and early called from school to rugged labor, are seeking to convert obstacle into opportunity, and wrest achievement from difficulty."

Though physically a weak child, his intellect was strong, and when near his tenth year his father removed to Vermont, the boy took with him the reputation of a mental prodigy; so, with little schooling and much reading, he was thought when 14 to be a fit apprentice to a printer, setting forth four years later as a journeyman. His parents had moved to western Pennsylvania, and he followed; but after a desultory practice of his art he came to the metropolis on August 17, 1831, with $10 in his pocket, and so rustic in dress and manners as to fall under suspicion of being a runaway apprentice. Later

in life, at least, his face and his figure would have lent distinction to the utmost elegance of style: but his dress was so careless even after the long period of comparative poverty was passed, that the peculiarity became one of his distinguishing features as a public character; and to the last there were friends of little discernment who thought this eccentricity was studied affectation: but manifestly his dress, like his unkempt handwriting was the unconscious expression of a spirit so concentrated on the intellectual interests of its life as to be oblivious to mere appearances.

After 18 months of dubious success in New York as a journeyman, in his 21st year, he joined a friend in setting up a modest printing-office, which on March 22, 1834, issued the 'New Yorker,' a literary weekly in the general style of Willis' 'Mirror,' under the firm name of H. Greeley & Company. For four years the young printer showed his editorial aptitude to such good effect that in 1838 he was asked to conduct the 'Jeffersonian,' a Whig campaign paper. This was so effective that in 1840 he was encouraged to edit and publish the 'Log-Cabin,' a weekly which gained a circulation of 80,000, brought him a reputation as a political writer, and active participation in politics with the Whig leaders, Gov. Seward and Thurlow Weed. It contributed much to the election of Gen. Harrison, but very little to the purse of the ambitious editor. On April 10 of the following year, 1841, he issued the first number of the New York *Tribune*, as a Whig daily of independent spirit. He was still editing the 'New-Yorker' and the 'Log-Cabin,' both of which were soon discontinued, the 'Weekly Tribune' in a way taking their place. Though the 'New-Yorker' had brought him literary reputation, it had not been profitable, because of uncollectible bills which at the end amounted to $10,000. Still, at the outset of the *Tribune* he was able to count $2,000 to his credit in cash and material. He was then 30 years of age, and for 30 years thereafter the paper grew steadily in circulation, influence, and profit, until, a few weeks after his death, a sale of the majority interest indicated that the "good-will" of the *Tribune*, aside from its material and real estate, was held to be worth about a million dollars. The Greeley interest was then small, since he had parted with most of it to sustain his generous methods of giving and lending.

He had great capacity for literary work, and when absent for travel or business was a copious contributor to his paper. To his rather delicate physical habit was perhaps due his distaste for all stimulants, alcoholic or otherwise, and his adherence through life to the vegetarian doctrines of Dr. Graham; another follower of the latter being his wife, Mary Young Cheney, also a writer, whom he married in 1836. His moderate advocacy of temperance in food and drink, coupled with his then unorthodox denial of eternal punishment, helped to identify him in the public mind with most of the "isms" of the time, including Fourierism and spiritualism; when in fact his mind and his paper were merely open to free inquiry, and were active in exposing vagaries of opinion wherever manifested. Protection to American industry, and abolitionism, were the only varieties which he accepted without qualification; and while the pro-slavery party detested him as a dangerous agitator, it is possible at this day even from their point of view to admire the moderation, the candor, and the gentle humanity of his treatment of the slavery question. In all issues concerning the practical affairs of life, like marriage and divorce, he was guided by rare common-sense, and usually his arguments were scholarly and moderate; but in matters of personal controversy he was distinctly human, uniting with a taste for the intellectual fray a command of facts, and a force and pungency of presentation, which never seem admirable in an opponent.

He was in great demand as a lecturer and as a speaker at agricultural fairs, his addresses always being distinguished by a desire to be helpful to working humanity and by elevated motives. Though not a jester, genial humor and intellectual exchange were characteristic of his social intercourse. His books, with one or two exceptions, were collections of his addresses and newspaper articles. His first book, 'Hints Toward Reforms,' appeared in 1850, and was followed by: 'Glances at Europe' (1851); 'A History of the Struggle for Slavery Extension or Restriction' (1856); 'The Overland Journey to California' (1859); 'An Address on Success in Business' (1867); 'Recollections of a Busy Life,' formed on a series of articles in the New York 'Ledger' (1869); 'Essays Designed to Elucidate the Science of Political Economy' (1870); 'Letters from Texas and the Lower Mississippi, and an Address to the Farmers of Texas' (1871); 'What I Know of Farming' (1871); and 'The American Conflict,' written as a book, the first volume appearing in 1864 and the second in 1867. This work on the Civil War is remarkable, when considered in the light of his purpose to show "the inevitable sequence whereby ideas proved the germ of events"; but it was hastily prepared, and while strikingly accurate in the large sense, will not bear scrutiny in some of the minor details of war history.

Neither his political friends, nor his party, nor the causes he espoused, could hold him to a course of partisan loyalty contrary to his own convictions of right and duty. As a member of the Seward-Weed-Greeley "triumvirate," he was often a thorn in the flesh of the senior members; his letter of Nov. 11, 1854, dissolving "the political firm," being one of the frankest documents in the history of American politics. During the Civil War he occasionally embarrassed Mr. Lincoln's administration by what seemed then to be untimely cries of "On to Richmond!" immediate emancipation, and peace. On the whole, his influence for the Union cause was powerful; but when, the War being over, he advocated general amnesty, and finally as an object lesson went on the bail bond of Jefferson Davis, he lost the support of a large body of his most ardent anti-slavery admirers. The clamor against him called forth a characteristic defiance in his letter to members of the Union League Club, who were seeking to discipline him. Having further alienated the Republican party by his general attitude in "reconstruction" matters, he became the logical candidate for the Presidency, in 1872, of the Democrats at Baltimore and the Liberal Republicans at Cincinnati, in opposition to a second term for Gen. Grant. Though personally he made a brilliant canvass,

the influences at work in his favor were inharmonious and disintegrating, and the result was a most humiliating defeat. This he appeared to bear with mental buoyancy, despite the affliction of his wife's death, which occurred a week before the election, he having left the stump in September to watch unremittingly at her bedside. On November 6, the day after his defeat, he resumed the editorship of the *Tribune*, which six months before he had relinquished to Whitelaw Reid. Thereafter he contributed to only four issues of the paper, for the strain of his domestic and political misfortunes had aggravated his tendency to insomnia; on the 12th he was seriously ill, and on the 29th he succumbed to inflammation of the brain. The last few months of his eventful career supplied most of the elements essential to a Greek tragedy. On December 23, the *Tribune* having been reorganized, with Mr. Reid in permanent control, there first appeared at the head of the editorial page the line "Founded by Horace Greeley," as a memorial to the great journalist and reformer. A bronze statue has been erected in the portal of the new *Tribune* office, and another statue in the angle made by Broadway and Sixth Avenue, appropriately named "Greeley Square," after the man who was second to no other citizen in establishing the intellectual ascendency of the metropolis. CLARENCE CLOUGH BUEL.

Greeley, Colo., city, county-seat of Weld County; on the Cache la Poudre River, the Union P. and the C. & S. Railroads; about 50 miles north of Denver. The place was settled in 1870 by the "Greeley Colony" (named after Horace Greeley), made up mainly of New England people. By irrigation they have made of the almost barren region an excellent agricultural country. It is the seat of a State Normal School. The chief manufactures are flour, beet-sugar, and lumber. Its trade is in its manufactured articles, also sheep, cattle, grain, and vegetables. Pop. (1900) 3,023.

Greely, Adolphus Washington, American Arctic explorer: b. Newburyport, Mass., 27 March 1844. After receiving a high school education he enlisted as a private in the 19th Massachusetts volunteer infantry, serving in the Civil War from 1861 to 1865. He entered the regular army in 1867 as second lieutenant and was appointed to the signal service. In 1881 he was put in command of an Arctic expedition, organized to carry out the plan of establishing circumpolar stations in accordance with the recommendations of the International Geographical Congress held at Hamburg in 1879. The exploring party made their headquarters for two years at Discovery Harbor, Grinnell Land. In an expedition made by a detailed party, the highest point north attained up to that date, 83° 24′, was reached. On his way back he reached Cape Sabine with great difficulty, and during the winter of 1883 lost, through cold and famine, all but seven of his twenty-five companions. Meanwhile Com. Winfield S. Schley had been despatched on a relief expedition, and in June 1884 rescued them at Cape Sabine. From his services to geographical science Lieutenant Greely was awarded the Founder's Medal of the Royal Geographical Society, and the Roquette Medal by the Société de Géographie of Paris. He was promoted to the rank of captain in the United States Army, and in 1887 succeeded Gen. W. B. Hazen as chief signal officer, with the rank of brigadier-general. Consult: Greely, 'Three Years of Arctic Service' (1886); Schley, 'The Rescue of Greely' (1885).

Green, Alice Sophia Amelia (STOPFORD), English historian: b. Kells, Ireland, 1849. She was privately educated. In 1877 she was married to J. R. Green (q.v.) the well-known historian. She collaborated with him in 'A Short Geography of the British Islands' (1879), edited his 'Conquest of England' (1883), prepared a revised edition (1888) and, with Miss K. Norgate, a finely illustrated edition (1892) of the 'Short History of the English People.' Her original works are 'Henry II.' (1888) and 'Town Life in the Fifteenth Century' (1894).

Green, Andrew Haswell, American lawyer: b. Worcester, Mass., 6 Oct. 1820; d. 13 Nov. 1903. He studied law, practised his profession in New York, and was there president of the board of commissioners of education, and comptroller (1871–6). In the latter capacity he re-established the municipal credit, seriously impaired by the embezzlements of the Tweed ring. He originated in 1868 the plan for Greater New York, executed in 1897, and also devised the plan for the consolidation of the Astor, Lenox, and Tilden foundations as the New York Public Library. He also assisted in establishing the American Museum of Natural History and the Metropolitan Museum of Art, and founded and became president of the New York Zoological Society. He was shot by Cornelius M. Williams, a negro, pronounced insane. It developed that he lost his life through resemblance to another against whom the assassin had a supposed grievance.

Green, Anna Katharine. See ROHLFS, ANNA K. G.

Green, Ashbel, American Presbyterian clergyman: b. 6 July 1762; d. 19 May 1848. He was graduated from the College of New Jersey (now Princeton University) in 1783, and appointed tutor and subsequently professor of mathematics and natural philosophy in that institution, which latter position he held for a year and a half. In 1786 he was licensed to preach and took up ministerial work in Philadelphia. From 1792 to 1800 he was chaplain to Congress, and in 1809 took a prominent part in forming the Philadelphia Bible Society, the earliest institution of the kind in the United States. He drafted the constitution of the Princeton theological seminary, of which he was one of the originators, and in 1812 was elected president of Princeton College. In 1822 he resigned this office and returned to Philadelphia to edit the 'Christian Advocate,' a religious monthly. For half a century he was one of the leading men in the Presbyterian Church. Among his many writings are 'Discourse Delivered in the College of New Jersey, with a History of the College' (1822); 'History of Presbyterian Missions'; 'Lectures on the Shorter Catechism.'

Green, Bartholomew, American publisher: b. Cambridge, Mass., 1666; d. 1732. He published the first newspaper that appeared in the American colonies, and succeeding to his father's business at Cambridge extended it at Boston, where the office of the 'Boston News Letter' was situated. The proprietor and editor was John Campbell, postmaster of Boston. He event-

ually bought in the paper, which became notable for outspokenness on topics of religion and politics.

Green, Beriah, American abolitionist: b. New York State 1794; d. 1874. He was educated at Middlebury College, Vermont, became professor of sacred literature in Western Reserve College in 1821, but was compelled to resign in a few months through the opposition aroused by his anti-slavery views. He was for many years president of the Oneida Institute, Ohio. He was a great friend of William Lloyd Garrison, and exerted a wide influence in abolitionist circles. Among his writings are 'History of the Quakers' (1823).

Green, Duff, American politician and journalist: b. Woodford County, Ky., 1791; d. Dalton, Ga., 1875. He served with the Kentucky militia in the War of 1812; after the admission of Missouri as a State was appointed State Senator (1823), and became editor and proprietor of the St. Louis *Enquirer*. In 1825 he removed to Washington, D. C., where he purchased the United States *Telegraph*. This became the administration organ, and Green rose to high favor with President Jackson. He was a member of the "Kitchen Cabinet." After the rupture between Calhoun and Jackson, the *Telegraph* as the organ of the nullificationists bitterly attacked Jackson. After some years spent in Europe he returned to the United States (1844) and edited a short-lived newspaper in New York. During the latter years of his life he was actively engaged in promoting the development of the South, and was one of the founders of the town of Dalton, Ga.

Green, Hetty Howland Robinson, American financier: b. New Bedford, Mass. 21 Nov. 1835. She is the richest woman in America and probably the boldest and ablest woman financier of her time. Although she has an interest in nearly every large corporation and important enterprise in the world, she manages personally her own property in stocks, bonds, and real estate in Chicago, New York, and elsewhere.

Green, Jacob, American Presbyterian clergyman: b. Malden, Mass., 1722; d. 1796. He became president of the College of New Jersey in 1757, and in 1775, as a member of the New Jersey Provincial Congress, was chairman of the committee chosen to prepare a State Constitution. He suggested in print a scheme for the redemption of the Continental currency, closely resembling that which Congress later adopted.

Green, John Cleve, American merchant and philanthropist: b. Lawrenceville, Mercer County, N. J., 14 April 1800; d. New York 28 April 1875. He entered a counting-house in New York, went as supercargo to South America and China, and in 1833 became a member of the firm of Russell & Co. at Canton. In 1839 he returned to New York, where he continued in the Chinese trade. For many years he was a director of the Chamber of Commerce, and officially connected with numerous public and charitable institutions. He was liberal in his gifts, particularly to New York University, and Princeton University. At Princeton he established (1873) the John C. Green School of Science by the gift of $50,000, subsequently increased by the residuary legatees. In this school instruction is given in general science, civil engineering, and electrical engineering. The courses are four years in length and lead to the degrees of bachelor of science, civil engineer and master of science. In 1902–3 the number of students in this department was 505. The endowed proprietary school for boys at Lawrenceville, N. J. was re-established in 1882 upon a gift from the executors of his estate known as 'The John C. Green Foundation.'

Green, John Richard, English historian: b. Oxford 1837; d. Mentone, France, 7 May 1883. He was graduated in 1859 from Jesus College, Oxford, where, since the study of modern history had not yet taken any considerable place in the university, the officers failed of sympathy with his preference for Matthew Paris to the classics. In 1860 he was ordained deacon and became curate of St. Barnabas, London, in 1863 was appointed to Holy Trinity, Hoxton, and in 1866 to St. Philip's, Stepney. Failing health and increasingly liberal views caused him to withdraw from clerical life, and from 1869 he was librarian at Lambeth. His first literary work of importance consisted of articles, especially brief essays, on historical subjects, in the 'Saturday Review.' In 1874, after having been twice rewritten, his 'Short History of the English People' appeared. This work unified English history as no other had yet done. 'What Macaulay had done for a period of English history,' says Creighton, 'Green did for it as a whole.' Green's purpose was to exhibit the development of popular life by a description of the leading manifestations of social progress. The book was skilful in arrangement and artistic in style, and met with an instant and large success. The author expanded it into his 'History of the English People' (1877–80), not only to secure greater fulness but also to defend views merely stated in the smaller work. He then attempted a history for scholars, of which but two parts were published — 'The Making of England' (1882), which extends from Britain as left by the Romans to the consolidation under Egbert, and secured his fame as a critical historian, particularly through his method of employing archæology for the purposes of history; and 'The Conquest of England' (1883), which continued the narrative to the arrival of the Normans. Green's influence on historical studies in England was very great, and his 'Short History' and 'History' still hold a foremost rank. The Oxford Historical Society and the 'English Historical Review' were originally suggested by him; and he further published: 'Stray Studies in England and Italy' (1876), a reprint of early papers; 'Readings from English History' (1879), a series of extracts; 'A Short Geography of the British Isles' (1880); and an edition of Addison's 'Essays' (1881). His 'Letters' were published in 1901.

Green, Joseph, American poet: b. Boston, Mass., 1706; d. London, England, 11 Dec. 1780. He was graduated at Harvard 1726, and was famous for his wit and satirical powers. During the War of the Revolution he was prominent on the Loyalist side. His works include: 'The Wonderful Lament of Old Mr. Tenor' (1744); 'Poems and Satires' (1780).

Green, Seth, American pisciculturist: b. Irondequoit, N. Y., 19 March 1817; d. Rochester, N. Y., 20 Aug. 1888. He learned the natural history necessary for his profession from observation and private reading, and began his

life's work by the artificial hatching of trout roe. He was looked upon as the leading expert in this department of fish culture, but his first great triumph in new fields came with his success in the reproduction of shad. The Seth Green shad-hatching box was invented in 1867, and, although it has been superseded, by this device shad culture was first demonstrated to be possible and its inventor must be looked upon as the pioneer in this difficult department of pisciculture. The Connecticut River was restocked by means of this invention. In 1868 he was made fish commissioner for the State of New York, and the following year undertook the artificial reproduction of whitefish. He was successful in his experiments, and was acknowledged as one of the fathers of fish culture in the United States. From 1870 until his death he was superintendent of the state hatchery at Caledonia, N. Y.

Green, Thomas Hill, English philosopher: b. Birkin, Yorkshire, 7 April 1836; d. Oxford, 15 March 1882. He was educated at Rugby and Oxford; was elected fellow at Balliol in 1862, the first lay tutor on that foundation (1867), and in 1878 Whyte professor of moral philosophy in the university. His principal work as a philosopher was the foundation of the so-called Neo-Hegelian School. He is supposed to have been taken by Mrs. Ward as a model for her Mr. Gray in 'Robert Elsmere'; but the resemblance is by no means complete, as Mr. Gray's work is undoubtedly, as he appears in 'Robert Elsmere,' rather that of a destructive literary critic than a constructive philosopher. His works include: 'Introduction to Hume's Treatise of Human Nature' (1874); and 'Prolegomena to Ethics' (1883.)

Green Bay, Wis., a city and county-seat of Brown County, situated at the head or southern point of the bay of the same name, and at the mouth of the Fox River, on the Chicago & Northwestern, Chicago, Milwaukee & St. Paul, the Green Bay & Western R. R.'s.

Commerce and Industry.— Green Bay has an extensive commerce. Twenty-four passenger trains arrive daily over the four railroads entering the city. An extensive lake traffic is also carried on, the harbor, through government appropriations, having been made accessible to the largest vessels upon the Great Lakes. Coal constitutes the largest single import, Green Bay being an advantageous distributing point. The largest export by way of the lakes is grain, although much lumber has hitherto been shipped out. A line of excursion steamers is also run to nearby summer resorts and to Mackinac and the "Soo." The city is provided with a complete electric railway system, including an interurban line up the Fox River valley to Kaukauna, where a junction is made with another electric line passing through Appleton, Neenah, Oshkosh and Fond du Lac. A light and power plant furnishes gas for lighting and heating and electricity for light and power, many electric motors now being in use. There are a number of manufacturing plants — 3 large breweries, 2 paper mills and 1 sulphite mill, 2 large saw mills, 2 planing mills, 1 very large canning factory, 1 shoe factory, 1 glove factory, 1 pure milk factory, 1 furniture factory, 2 woodenware factories, 3 machine shops, 1 candy and biscuit factory, 1 pickle factory, 1 coffin factory, 1 carriage factory, 1 cornice factory, 1 paper-box factory. Several jobbing and wholesale houses do a large business, the most important being a grocery house, a hardware house, and a crockery house. An extensive fish-shipping business is also carried on. Water is supplied from artesian wells by a private company.

Educational Institutions, Etc.— Green Bay has a number of fine public buildings, the Kellogg library, the Federal Buildings, Saint Joseph's Academy, three Hospitals, and just outside the city limits the State Reform School. The public school system consists of 2 high schools and 13 ward schools, employing 84 teachers. There are also several parish schools, graded in the same manner as the public schools. There are 6 Roman Catholic churches, 2 Baptist 2 Congregational, 1 Episcopal, 2 Evangelical, 2 Lutheran, 4 Methodist, 2 Moravian, 2 Presbyterian, and 1 Christian Scientist.

History.— Green Bay, the oldest town in Wisconsin, was first visited in 1634 by Jean Nicollet, who had been sent by Champlain, governor of New France, to find the rumored short route to China. The site was a favorable one for an Indian village as well as a landing place for explorers and missionaries. It is known that Marquette, Joliet, Allouez, and Tonti spent considerable time here. The town was therefore settled by the French, who impressed their character upon it for over 200 years, although it fell into the hands of the English at the close of the French and Indian war in 1763. In 1816 the Americans established a fort on the opposite side of the river, known as Fort Howard, around which a prosperous town of the same name grew up. In 1895 Fort Howard was annexed to Green Bay, and is now known as the West-Side.

Government, Etc.— The government of the city is administered by a mayor and common council, the latter consisting of sixteen members, elected for two years, two from each ward. Assessed valuation: Lots exclusive of buildings, \$4,150,235; buildings, \$4,279,740; personal property, \$2,827,140; total, \$11,257,115. Pop. (1903 est.) 20,142.

A. W. Burton,
Superintendent of Schools.

Green Bay, an arm of Lake Michigan, on the southwestern coast of the upper peninsula of Michigan and the eastern coast of Wisconsin. It is 120 miles long, from 10 to 20 miles wide, has an average depth of about 100 feet. Fox River, the outlet of Lake Winnebago, enters the bay at its head, at the city of Green Bay. The bay is navigable for the largest lake steamers. The largest cities on the bay are Green Bay and Marinette, in Wisconsin, and Menominee and Escanaba in Michigan.

Green Cove Springs, Fla., town, county-seat of Clay County; on the St. John's River, the Jacksonville, T. & K. W. railroad. It contains a warm sulphur spring noted for its medicinal properties. The trade is chiefly in fruits, vegetables, and lumber. Pop. 1,015.

Green Island, N. Y., a village of Albany County, on an island in the Hudson River opposite Troy, on the Delaware & H. and the New York C. & H. R. R.R.'s. It is connected with Watervliet and Troy by bridges; and has iron manufactories, machine shops and railroad car shops. Pop. (1900) 4,770.

ually bought in the paper, which became notable for outspokenness on topics of religion and politics.

Green, Beriah, American abolitionist: b. New York State 1794; d. 1874. He was educated at Middlebury College, Vermont, became professor of sacred literature in Western Reserve College in 1821, but was compelled to resign in a few months through the opposition aroused by his anti-slavery views. He was for many years president of the Oneida Institute, Ohio. He was a great friend of William Lloyd Garrison, and exerted a wide influence in abolitionist circles. Among his writings are 'History of the Quakers' (1823).

Green, Duff, American politician and journalist: b. Woodford County, Ky., 1791; d. Dalton, Ga., 1875. He served with the Kentucky militia in the War of 1812; after the admission of Missouri as a State was appointed State Senator (1823), and became editor and proprietor of the St. Louis *Enquirer*. In 1825 he removed to Washington, D. C., where he purchased the United States *Telegraph*. This became the administration organ, and Green rose to high favor with President Jackson. He was a member of the "Kitchen Cabinet." After the rupture between Calhoun and Jackson, the *Telegraph* as the organ of the nullificationists bitterly attacked Jackson. After some years spent in Europe he returned to the United States (1844) and edited a short-lived newspaper in New York. During the latter years of his life he was actively engaged in promoting the development of the South, and was one of the founders of the town of Dalton, Ga.

Green, Hetty Howland Robinson, American financier: b. New Bedford, Mass., 21 Nov. 1835. She is the richest woman in America and probably the boldest and ablest woman financier of her time. Although she has an interest in nearly every large corporation and important enterprise in the world, she manages personally her own property in stocks, bonds, and real estate in Chicago, New York, and elsewhere.

Green, Jacob, American Presbyterian clergyman: b. Malden, Mass., 1722; d. 1796. He became president of the College of New Jersey in 1757, and in 1775, as a member of the New Jersey Provincial Congress, was chairman of the committee chosen to prepare a State Constitution. He suggested in print a scheme for the redemption of the Continental currency, closely resembling that which Congress later adopted.

Green, John Cleve, American merchant and philanthropist: b. Lawrenceville, Mercer County, N. J., 14 April 1800; d. New York 28 April 1875. He entered a counting-house in New York, went as supercargo to South America and China, and in 1833 became a member of the firm of Russell & Co. at Canton. In 1839 he returned to New York, where he continued in the Chinese trade. For many years he was a director of the Chamber of Commerce, and officially connected with numerous public and charitable institutions. He was liberal in his gifts, particularly to New York University, and Princeton University. At Princeton he established (1873) the John C. Green School of Science by the gift of $50,000, subsequently increased by the residuary legatees. In this school instruction is given in general science, civil engineering, and electrical engineering. The courses are four years in length and lead to the degrees of bachelor of science, civil engineer and master of science. In 1902–3 the number of students in this department was 505. The endowed proprietary school for boys at Lawrenceville, N. J. was re-established in 1882 upon a gift from the executors of his estate known as 'The John C. Green Foundation.'

Green, John Richard, English historian: b. Oxford 1837; d. Mentone, France, 7 May 1883. He was graduated in 1859 from Jesus College, Oxford, where, since the study of modern history had not yet taken any considerable place in the university, the officers failed of sympathy with his preference for Matthew Paris to the classics. In 1860 he was ordained deacon and became curate of St. Barnabas, London, in 1863 was appointed to Holy Trinity, Hoxton, and in 1866 to St. Philip's, Stepney. Failing health and increasingly liberal views caused him to withdraw from clerical life, and from 1869 he was librarian at Lambeth. His first literary work of importance consisted of articles, especially brief essays, on historical subjects, in the 'Saturday Review.' In 1874, after having been twice rewritten, his 'Short History of the English People' appeared. This work unified English history as no other had yet done. 'What Macaulay had done for a period of English history,' says Creighton, 'Green did for it as a whole.' Green's purpose was to exhibit the development of popular life by a description of the leading manifestations of social progress. The book was skilful in arrangement and artistic in style, and met with an instant and large success. The author expanded it into his 'History of the English People' (1877–80), not only to secure greater fulness but also to defend views merely stated in the smaller work. He then attempted a history for scholars, of which but two parts were published — 'The Making of England' (1882), which extends from Britain as left by the Romans to the consolidation under Egbert, and secured his fame as a critical historian, particularly through his method of employing archæology for the purposes of history; and 'The Conquest of England' (1883), which continued the narrative to the arrival of the Normans. Green's influence on historical studies in England was very great, and his 'Short History' and 'History' still hold a foremost rank. The Oxford Historical Society and the 'English Historical Review' were originally suggested by him; and he further published: 'Stray Studies in England and Italy' (1876), a reprint of early papers; 'Readings from English History' (1879), a series of extracts; 'A Short Geography of the British Isles' (1880); and an edition of Addison's 'Essays' (1881). His 'Letters' were published in 1901.

Green, Joseph, American poet: b. Boston, Mass., 1706; d. London, England, 11 Dec. 1780. He was graduated at Harvard 1726, and was famous for his wit and satirical powers. During the War of the Revolution he was prominent on the Loyalist side. His works include: 'The Wonderful Lament of Old Mr. Tenor' (1744); 'Poems and Satires' (1780).

Green, Seth, American pisciculturist: b. Irondequoit, N. Y., 19 March 1817; d. Rochester, N. Y., 20 Aug. 1888. He learned the natural history necessary for his profession from observation and private reading, and began his

life's work by the artificial hatching of trout roe. He was looked upon as the leading expert in this department of fish culture, but his first great triumph in new fields came with his success in the reproduction of shad. The Seth Green shad-hatching box was invented in 1867, and, although it has been superseded, by this device shad culture was first demonstrated to be possible and its inventor must be looked upon as the pioneer in this difficult department of pisciculture. The Connecticut River was restocked by means of this invention. In 1868 he was made fish commissioner for the State of New York, and the following year undertook the artificial reproduction of whitefish. He was successful in his experiments, and was acknowledged as one of the fathers of fish culture in the United States. From 1870 until his death he was superintendent of the state hatchery at Caledonia, N. Y.

Green, Thomas Hill, English philosopher: b. Birkin, Yorkshire, 7 April 1836; d. Oxford, 15 March 1882. He was educated at Rugby and Oxford; was elected fellow at Balliol in 1862, the first lay tutor on that foundation (1867), and in 1878 Whyte professor of moral philosophy in the university. His principal work as a philosopher was the foundation of the so-called Neo-Hegelian School. He is supposed to have been taken by Mrs. Ward as a model for her Mr. Gray in 'Robert Elsmere'; but the resemblance is by no means complete, as Mr. Gray's work is undoubtedly, as he appears in 'Robert Elsmere,' rather that of a destructive literary critic than a constructive philosopher. His works include: 'Introduction to Hume's Treatise of Human Nature' (1874); and 'Prolegomena to Ethics' (1883.)

Green Bay, Wis., a city and county-seat of Brown County, situated at the head or southern point of the bay of the same name, and at the mouth of the Fox River, on the Chicago & Northwestern, Chicago, Milwaukee & St. Paul, the Green Bay & Western R. R.'s.

Commerce and Industry.— Green Bay has an extensive commerce. Twenty-four passenger trains arrive daily over the four railroads entering the city. An extensive lake traffic is also carried on, the harbor, through government appropriations, having been made accessible to the largest vessels upon the Great Lakes. Coal constitutes the largest single import, Green Bay being an advantageous distributing point. The largest export by way of the lakes is grain, although much lumber has hitherto been shipped out. A line of excursion steamers is also run to nearby summer resorts and to Mackinac and the "Soo." The city is provided with a complete electric railway system, including an interurban line up the Fox River valley to Kaukauna, where a junction is made with another electric line passing through Appleton, Neenah, Oshkosh and Fond du Lac. A light and power plant furnishes gas for lighting and heating and electricity for light and power, many electric motors now being in use. There are a number of manufacturing plants — 3 large breweries, 2 paper mills and 1 sulphite mill, 2 large saw mills, 2 planing mills, 1 very large canning factory, 1 shoe factory, 1 glove factory, 1 pure milk factory, 1 furniture factory, 2 woodenware factories, 3 machine shops, 1 candy and biscuit factory, 1 pickle factory, 1 coffin factory, 1 carriage factory, 1 cornice factory, 1 paper-box factory. Several jobbing and wholesale houses do a large business, the most important being a grocery house, a hardware house, and a crockery house. An extensive fish-shipping business is also carried on. Water is supplied from artesian wells by a private company.

Educational Institutions, Etc.— Green Bay has a number of fine public buildings, the Kellogg library, the Federal Buildings, Saint Joseph's Academy, three Hospitals, and just outside the city limits the State Reform School. The public school system consists of 2 high schools and 13 ward schools, employing 84 teachers. There are also several parish schools, graded in the same manner as the public schools. There are 6 Roman Catholic churches, 2 Baptist 2 Congregational, 1 Episcopal, 2 Evangelical, 2 Lutheran, 4 Methodist, 2 Moravian, 2 Presbyterian, and 1 Christian Scientist.

History.— Green Bay, the oldest town in Wisconsin, was first visited in 1634 by Jean Nicollet, who had been sent by Champlain, governor of New France, to find the rumored short route to China. The site was a favorable one for an Indian village as well as a landing place for explorers and missionaries. It is known that Marquette, Joliet, Allouez, and Tonti spent considerable time here. The town was therefore settled by the French, who impressed their character upon it for over 200 years, although it fell into the hands of the English at the close of the French and Indian war in 1763. In 1816 the Americans established a fort on the opposite side of the river, known as Fort Howard, around which a prosperous town of the same name grew up. In 1895 Fort Howard was annexed to Green Bay, and is now known as the West-Side.

Government, Etc.— The government of the city is administered by a mayor and common council, the latter consisting of sixteen members, elected for two years, two from each ward. Assessed valuation: Lots exclusive of buildings, $4,150,235; buildings, $4,279,740; personal property, $2,827,140; total, $11,257,115. Pop. (1903 est.) 20,142.

A. W. Burton,
Superintendent of Schools.

Green Bay, an arm of Lake Michigan, on the southwestern coast of the upper peninsula of Michigan and the eastern coast of Wisconsin. It is 120 miles long, from 10 to 20 miles wide, has an average depth of about 100 feet. Fox River, the outlet of Lake Winnebago, enters the bay at its head, at the city of Green Bay. The bay is navigable for the largest lake steamers. The largest cities on the bay are Green Bay and Marinette, in Wisconsin, and Menominee and Escanaba in Michigan.

Green Cove Springs, Fla., town, county-seat of Clay County; on the St. John's River, the Jacksonville, T. & K. W. railroad. It contains a warm sulphur spring noted for its medicinal properties. The trade is chiefly in fruits, vegetables, and lumber. Pop. 1,015.

Green Island, N. Y., a village of Albany County, on an island in the Hudson River opposite Troy, on the Delaware & H. and the New York C. & H. R. R.R.'s. It is connected with Watervliet and Troy by bridges; and has iron manufactories, machine shops and railroad car shops. Pop. (1900) 4,770.

Green Manuring, the agricultural practice of plowing under crops while succulent in order that they may enrich the surface layer by their decay. It is of ancient origin and wide popularity, especially in mild climates; less in tropical than it should be. The objects gained are the opening of the soil and especially the subsoil by the roots of deep feeding plants; the raising of plant food from the lower strata to the surface layer and the saving of available plant food in the surface layer, material that would leach away beyond the reach of shallow-rooted plants; the addition of humus to the soil by the decay of the plants; and, with certain crops, the addition of nitrogenous foods obtained from the air. As the plants decay they also act upon insoluble plant food in the soil and make it available. They belong to two classes: (1) shallow-rooted plants such as rye, buckwheat, mustard, rape, etc., which are specially useful on hard and poor soils open the way for more exacting crops; (2) deep-rooted plants such as clover, cow-pea, velvet bean, vetch and other leguminous plants which are still further useful because of their power of obtaining nitrogen from the air. See CLOVER; FERTILIZERS; LEGUMINOUS PLANTS; MANURES AND MANURING; ROOT-TUBERCLES; SOIL, and articles on the crops mentioned.

Green Monkeys, three similar species of small African monkeys, often seen in menageries, and representing the genus *Cercopithecus,* may properly be called green monkeys because of the prevailing tint of their fur. The one most commonly seen is *C. callitrichus,* the size of a cat, and remarkable for its unbroken silence. The vervet (*C. lalandi*) is smaller, grayish green, reddish white on the cheeks, throat and underparts, while the face, paws and end of the tail are jet black. It is common all over South Africa, where no other species of its large genus are found. The grivet (*C. griseoviridis*) is speckled olive-green, with a whitish forehead, chin and rump; it dwells in Abyssinia and is not numerous. All these monkeys, at least when young, are exceedingly docile and good-natured in captivity.

Green Mountain Boys, the regiments of Vermont settlers raised to defend the New Hampshire grantees against the efforts of New York to oust them or collect quit-rents, and later for service in the Revolution. See ALLEN, ETHAN.

Green Mountain State, a popular name for the State of Vermont, from its being crossed by the Green Mountains. See GREEN MOUNTAINS; VERMONT.

Green Mountains, a range belonging to the Appalachian system properly extending from near Long Island Sound through the western part of Connecticut and Massachusetts, into Vermont and Canada. In the State of Vermont the range is known as Green Mountains; but south, in Massachusetts and Connecticut, it is called by the names Berkshire Hills, Taconic Mountains, and Hoosac Mountains. The peaks of this range, one of the oldest in North America, have been worn down by erosion and weathering, until in many places they have become low, round hills. Their greatest elevation is in Vermont; Mounts Killington, Mansfield, Camels Hump, Lincoln, and Jay being the highest. Summit, a hamlet in the town of Mount Holly, in Rutland County, is the highest point crossed by a railroad. Some of the best building stone in the country is obtained from the Green Mountains. Granite and marble exist in large quantities, and on the western slope are layers of red sandstone. Iron and slate abound, and copper and manganese are found in several places. The range forms the divide between the basin of the Connecticut on the east and the Lake Champlain and Hudson River basins on the west. The rivers rising in the Green Mountains are short streams, but their water-power is abundant. In the fertile valleys are rich farms, and sheep and cattle are raised on the uplands. The hemlock, spruce, pine, and other evergreens which form striking parts of the forests, have given the name to this range. Hard wood trees and the sugar maple are found on both the east and west slopes of the mountains. The beauty of the scenery and the climate make the Green Mountains a place much frequented in summer by tourists.

Green River, in Kentucky, has its rise in Lincoln County, flows south and west to Adair County; west, a very irregular course, to Butler County; then northwest to the Ohio River which it enters a few miles above Evansville, Ind. It is about 350 miles long, and is navigable for small steamers for a distance of about 200 miles from the Ohio; but for a part of this distance artificial means have been used to make it navigable. In Edmonson County this river passes within 80 feet of the mouth of Mammoth Cave. The subterranean stream called Echo River, which is seen in connection with the Mammoth Cave, flows into Green River.

Green River, in Utah, has its rise in the western part of Wyoming, flows south and east into Colorado, south and west into Utah, then in a southern direction to the southeastern part of the State where it unites with the Grand to form the Colorado River. Major Powell (q.v.) and other explorers have passed through several of the remarkable cañons of this river. Its length is about 525 miles.

Green Snake, in the United States, a very slender, agile, harmless, grass-green, yellow-bellied serpent (*Liopeltis vernalis*), which is not only common in grassy places but in bushes, its color concealing it well in both places. It feeds mainly on insects. Several poisonous serpents of the far East, are called "green snakes" by English-speaking residents on account of their color.

Green Springs, Va., Battle of, 6 July 1781. Lafayette, reinforced by Steuben, was pressing close on Cornwallis' rear down York peninsula; and the advance-guard under Wayne came unexpectedly upon an entire division of the British at Green Springs, on the James River. Immediate retreat meaning destruction, he charged them so fiercely that Cornwallis, thinking the entire American army was upon him, merely repelled the assaulting party and drew off his men, while Wayne retreated in the other direction. The American loss was 145.

Green Vitriol. See COPPERAS.

Green'away, Kate, English artist: b. London 1846; d. there 8 Nov. 1901. She studied at Heatherley's, South Kensington, and the Slade School, and first exhibited in 1868 at the Dudley Gallery. For many years her work regularly appeared in the exhibitions of the Water Color

Society and the Academy. Her illustrations were widely published and popular in the United States as well as in Great Britain. She became especially famous for her pictures of child life, characterized by individuality of design, skilful coloring, and humorous touches. Her books include 'A Painting Book for Boys and Girls' and 'Kate Greenaway Birthday Book.'

Greenback-Labor Party, or **National Party.** The workingmen during the "panic years" (1874–8) increasingly resorted to political activity to right their grievances, and in Ohio in 1877 began to call their local organization the "National Party." In Massachusetts and Pennsylvania they fused with the Greenback Party (q.v.). On 22 Feb. 1878, at Toledo, Ohio, they held a convention which organized the fusion as the "National Party;" but the popular name for it was the old fusion name "Greenback-Labor." Their platform was the Greenback one, with planks against prison contract labor and in favor of legislation for shorter hours. The new organization awakened hopes in the hopeless minorities in several States where the majority, Republican or Democratic, could not be overturned; and they organized fusions with it, which raised it at once to a popular vote (apparently) of over 1,000,000, and elected 14 Congressmen. In the close States each old party kept its own vote, with a slight falling off to the new one. The party proper elected but two representatives, five of the 14 being really Republicans and seven Democrats. In 1880 (9–10 June) it held a national convention at Chicago, and nominated James B. Weaver of Iowa, and B. J. Chambers of Texas, for President and Vice-President; Chambers declined, but no substitute was nominated. The platform had all the old planks in substance, and new ones against Chinese immigration, land-grants to railroads, and favors to corporations and bondholders, and in favor of sanitary regulations for manufactories. The fusions had largely disappeared, and the popular vote sunk to 306,867, and the Congressmen to eight; four from Missouri, two from Maine, one from New York, and one from Texas. It retained its organization till 1884,when it fused with the Anti-Monopoly Party (q.v.) and nominated Benjamin F. Butler for the Presidency, polling in all 175,380 votes. It then practically disappeared.

Greenback Party (its own name Independent Party), 1874–6. The prosperity of western agriculture during the War, due largely to the heavy government purchases and the payability of mortgages in depreciated paper, was attributed by a large section there to the plentifulness of the paper by itself; hence, when hard times had succeeded, it was believed that a fresh inflation of greenbacks would reproduce the same conditions. The chief obstacle to this was thought to be the eastern banking interests, which, having bought government bonds in greenbacks, had obtained the act of 1869 making them payable in coin whether so specified or not; and should have been forced to take what they gave, the more since paper was now at par and their bonds were not taxed. By 1868 the Ohio Democrats, led by George H. Pendleton, were insisting on the payment in greenbacks of all bonds not specifically payable in coin, as the 5–20's; this was called the "Ohio Idea." Western Democratic conventions placed this plank in their platforms for three or four years, but the nomination of Greeley put an end to that in 1872. The revival of greenbackism is often attributed to the silver demonetization act of 1873; but in fact silver was above par at that time, the act drew no general attention, and but for the later fall in silver probably never would have done so. The real cause was the bringing forward of the Resumption Act, passed 14 Jan. 1875, to take effect 1879. On 25 Nov. 1874 a Greenback convention was held to protest against it, and adopted three resolutions — (1) that all bank and corporation currency should be withdrawn; (2) that no currency be allowed except government paper "based on the faith and resources of the nation," and exchangeable on demand for 3.65 per cent bonds; (3) that coin should be paid only for interest on the national debt, and for that part of the principal which promised it. Several Democratic conventions indorsed these; but in 1876 the prospect of the hard-money Tilden being the next Presidential candidate, led the party to form an organization of its own. At a convention at Indianapolis, 17 May, they nominated Peter Cooper of New York and Newton Booth of California for President and Vice-President; Booth declined, and Samuel F. Cary of Ohio was substituted. The platform, besides the three points above, demanded the repeal of the Resumption Act. The ticket polled 81,737 votes, over half of them in Michigan, Illinois, Indiana, Iowa, and Kansas. In the State elections the next year the party polled 187,095 votes, but the main strength continued to be in the West. The next year it was absorbed in the Greenback-Labor Party (q.v.).

Greenbacks (as printed in green ink), the current name, from the first, of the legal-tender notes first issued by the government during the Civil War. (See Debt, National.) The authorizing act was signed by Lincoln 25 Feb. 1862; it was the first ever passed by Congress making anything but coin legal tender, and nearly all the Democrats and many Republicans declared it unconstitutional. But war necessities were too exigent, and the bill authorized $150,000,000 of the notes, not receivable for import dues nor payable by the government as interest on its obligations. On 11 June 1862 and 3 March 1863 further issues were authorized; and on 3 Jan. 1864 they reached their maximum amount of $449,338,902. The great inflation, the uncertain fortunes of the War, and the belief that even if victorious the United States neither could nor would pay its enormous debt at face value, but would repudiate or scale it, combined to depreciate the value of the notes; throughout 1864 they were worth on an average only about 45 cents on the dollar, and on one day, 11 July, when Early was threatening Washington, they dropped in panic to about 35 cents — or as currently expressed, the "premium on gold" was 285. The legal-tender acts had always been understood to be temporary war measures only, and a choice of evils; the secretary of the treasury (McCulloch) in his report for 1865, expressed the opinion that they ought not to be in force a day longer than was necessary to prepare for a return to the gold standard. The House passed a resolution of cordial concurrence, 144 to 6; and on 12 March 1866 both houses agreed on a reducing act, by which on 31 Dec. 1867 the volume of greenbacks stood at $356,000,000. But the demoralization of economic sentiment and

judgment wrought by them, which afterward issued in the Greenback party, was already at work; many attributed the prosperity of the time to the currency inflation, and even in Congress a majority had determined to make the paper currency a permanent feature of our finance. On 4 Feb. 1868 any further reduction was prohibited, and the volume stood at this mark till October 1872, when it began to increase, amounting on 15 Jan. 1874 to $372,979,815. On 20 June 1874 the maximum was fixed at $382,000,000. Meantime a test case had been made up to try the question of their constitutionality (Hepburn *v.* Griswold: see LEGAL TENDER CASES), and in 1869 the Supreme Court, by five to three, headed by Chief-Justice Chase, decided against them. The fiercest political opposition was roused by this, however, and it became a party question. The Supreme Court, in May 1871, reversed its decision by one majority. This experience has led the Supreme Court to be excessively cautious about taking jurisdiction in any case where strong political feeling is involved. The question of legal tender has become unimportant since the passage of the "Gold Standard Bill" (q.v.), under which no depreciation in value is possible.

Green'brier, any of various prickly vines of the genus *Smilax* (q.v.), commonly the catbrier (*S. rotundifolia*), which grows all over the eastern half of the United States and is especially numerous in the Southern Alleghanies, where it designates various mountain-ranges, streams, etc.

Greenbrier Mountains, a range of mountains in the eastern part of West Virginia, lying west of the main part of the Alleghanies and parallel to the Greenbrier River (q.v.). Their average height is about 2,000 feet, the highest point being about 3,500 feet.

Greenbrier River, a river of West Virginia, rising in the Rich Mountains, Randolph County, flowing southwest into New River; length 150 miles.

Greenbrier White Sulphur Springs, W. Va., the name sometimes given the White Sulphur Springs in the Greenbrier Mountains to distinguish them from less important springs of similar character. See WHITE SULPHUR SPRINGS, W. Va.

Green'bush, N. Y., formerly a town now a part of the city of Rensselaer in Rensselaer County on the Hudson River and the Boston & A. and the New York C. & H. R. Railroads. See RENSSELAER.

Green'castle, Ind., city and county-seat of Putnam County, on the Cleveland, C., C. & St. L., the Louisville, N., A. & C. and the Vandalia Line R.R.'s; 35 miles northeast of Terre Haute. It is the seat of De Pauw University, with her 9 large buildings. She has excellent public schools and a fine library building containing 7,000 volumes. It was settled in 1822 and incorporated in 1849. The form of government is by a mayor and a municipal council elected every two years. Greencastle contains lumber-mills and manufactories of lightning rods, pumps, and one of the largest and best equipped tin-plate factories in the world. Pop. (1904) 4,200.

Greene, Aella, American journalist and poet: b. Chester, Mass., 1838; d. Springfield, Mass., 1903. He was the author of: 'Rhymes of Yankee-Land'; 'Into the Sunshine' (1881); 'Stanza and Sequel' (1884); 'Gathered from Life.'

Greene, Albert Gorton, American lawyer and poet: b. Providence, R. I., 10 Feb. 1802; d. Cleveland, Ohio, 4 Jan. 1868. Graduated from Brown University 1820, he was admitted to the bar in 1823; in 1832 became clerk of the town and of the municipal court of Providence, and in 1858 judge of the court. From 1867 he was in Cleveland, Ohio. He was at one time president of the Rhode Island Historical Society, was a founder of the Providence Athenæum, began the Harris collection of American verse (now at Brown University), and wrote some well-known poems, such as 'Old Grimes' and 'The Baron's Last Banquet.'

Greene, Charles Ezra, American engineer: b. Cambridge, Mass., 12 Feb. 1842; d. Ann Arbor, Mich., 17 Oct. 1903. Graduated from Harvard in 1862 and from the Massachusetts Institute of Technology in 1868, he was United States assistant engineer in 1870–1, city engineer of Bangor, Maine, in 1871–2, and in 1872 became professor of civil engineering in the University of Michigan. He also practised as consulting engineer, and in 1876–7 was associate-editor of the 'Engineering News.' His writings include: 'Graphical Method of Analysis of Bridge Trusses' (1875), 'Structural Mechanics' (1897), and other technical works.

Greene, Christopher, American soldier: b. Warwick, R. I., 1737; d. Westchester County, N. Y., 13 May 1781. He was among the first to take the field on the American side after the engagements at Lexington and Concord. Subsequently, as colonel of a Rhode Island regiment, he participated in the campaign in Canada under Arnold. In 1777, while in command at Fort Mercer at Red Bank, on the Delaware, he sustained an attack from a large force of Hessians under Col. Donop, who were repulsed with great slaughter. For these services a sword was voted him by Congress, and a monument commemorative of the battle and of the valor of the American commander was erected in the neighborhood of Fort Mercer in 1829.

Greene, Edward Lee, American botanist: b. Hopkinton, R. I., 20 Aug. 1843. After studying at Albion College, Wis., he took orders in the Protestant Episcopal Church (1871); but in 1885 entered the Church of Rome. He has been professor of botany at the Roman Catholic University in Washington since 1895, and has published 'Illustrations of West American Oaks' (1890); 'Flora Franciscana' (1891); and 'Pittonia' (1890).

Greene, Francis Vinton, American soldier: b. Providence, R. I., 27 June 1850. He was graduated at West Point with the rank of second lieutenant of artillery. In 1876 he was made military attaché at St. Petersburg and remained at the headquarters of the Russian army during the Russo-Turkish War (1877–8), in the course of which he was twice decorated for bravery. Obtaining his captaincy in 1883 he was three years later appointed instructor in military engineering at West Point, but left the service to join the Barber Asphalt Company, and was president of the National Asphalt Company when the trust went into the hands of receivers. He entered the National Guard in

1889 on the staff of Gen. Louis Fitzgerald and was elected colonel of the Seventy-first regiment in 1892. In the Spanish-American War he was commissioned major-general of volunteers and served principally in the Philippines. In 1902 he was appointed police commissioner of New York. He has written: 'The Russian Army and its Campaign in Turkey' (1879); 'Army Life in Russia' (1880); 'The Mississippi' (1882); 'Life of General Nathanael Greene' (1893).

Greene, George Sears, American civil engineer and soldier: b. Warwick, R. I., 6 May 1801; d. Morristown, N. J., 28 Jan. 1899. He was graduated at West Point in 1823 and was for several years one of the professors there, but in 1836 adopted civil engineering as a profession, after sending in his resignation as an officer in the United States army. He was engaged subsequently in railway construction in many eastern States, and in 1856 the Croton Aqueduct Department of New York city commissioned him to execute several important works. He designed and constructed the reservoir in Central Park, widened High Bridge, and built a water tower and reservoir at its western extremity. At the beginning of the Civil War he took command of the Sixtieth New York Volunteers, and was put in command of a brigade at Cedar Mountain and a division at Antietam. He took part in many other important events of the war and was severely wounded in an engagement near Chattanooga, in 1863. In 1866 he retired from the army and the following year was appointed commissioner and chief engineer of the Croton Aqueduct Department, and in 1871 was called to Washington, D. C., as chief engineer of public works. During his three years' incumbency of that office he planned the sewer system of the national capital.

Greene, George Washington, American historian: b. East Greenwich, R. I., 8 April 1811; d. there 2 Feb. 1883. He was a grandson of Gen. Nathanael Greene (q.v.) of Revolutionary fame. After study in Brown University, he traveled extensively in Europe, was United States consul at Rome in 1839–45, and from 1848 until his resignation in 1852 was professor of modern languages at Brown University. He was appointed non-resident professor of history at Cornell in 1872. His publications include several historical works, such as: 'Historical View of the American Revolution' (1865), 'Life of Nathanael Greene' (1867–71), 'The German Element in the War of American Independence' (1876), and a 'Short History of Rhode Island' (1877).

Greene, Homer, American author and lawyer: b. Ariel, Pa., 10 Jan. 1853. He was graduated from Union College in 1876, from the Albany Law School in 1878, was admitted to the bar in 1879, and entered practice at Honesdale, Pa. In Pennsylvania politics he has been active as a Republican. He has contributed much verse and prose to the magazines, and published: 'The Blind Brother,' 'Burnham Breaker,' 'Coal and the Coal Mines,' and 'The Riverpark Rebellion.'

Greene, Nathanael, American soldier: b. Patawomut, Warwick County, R. I., 7 Aug. 1742; d. Mulberry Grove, Ga., 19 June 1786. His father, a leading preacher among the Quakers, was the owner of an anchor forge and a grist mill. He was brought up as a Quaker, and trained from childhood to work on the farm and at the forge. Resolute perseverance in the midst of many obstacles gave him in the course of time a more than ordinary familiarity with ancient and English history, geometry, law, and moral and political science. In 1770 he was chosen a member of the general assembly for Coventry, whither he had removed to take charge of another forge; and from that time continued to take an active part in public affairs. He was one of the first to engage in the military exercises which prepared the way for resistance to the encroachments of the mother country, and this open renunciation of the principles of his sect was promptly followed by formal excommunication. In 1774 he joined the Kentish guards as a private; in July of the same year was married to Catharine Littlefield of Block Island, and in 1775 was appointed by the general assembly to command as brigadier-general the Rhode Island contingent to the army before Boston. He joined his command at Roxbury on 3 June and from that time remained in active service without a day's furlough till the final disbandment of the army in 1783. At Boston his brigade was distinguished by its discipline, and after the evacuation he was entrusted with the defense of Long Island. He distinguished himself in the battle of Harlem Heights, later commanded a portion of Washington's army near Ft. Washington on the Hudson, and in September he was made major-general, and appointed to the command in New Jersey. At Trenton he led the division with which Washington marched in person, and, with Knox, was for following up the advantages of that brilliant surprise by advancing directly upon the other detachments of the enemy. He took an equal part in the battle of Princeton, and was entrusted by Washington during the winter with a confidential communication to Congress. At the Brandywine he commanded a division, and by a rapid march and successful stand preserved the army from utter destruction. At Germantown he commanded the left wing which penetrated into the village. On 2 March 1778, he accepted the office of quartermaster-general, which he held till August 1780, fulfilling its arduous and complicated duties in such a manner as to call forth from Washington when he left it the declaration "that the States have had in you, in my opinion, an able, upright, and diligent servant." On 23 June 1780, he checked with two brigades and a small body of militia the advance of a corps of 5,000 of the enemy in the brilliant battle of Springfield. He was in command of the army during Washington's visit to Hartford in September 1780, when Arnold's conspiracy was discovered, and sat as president of the court of inquiry upon Major André. In October of the same year, he was appointed to the command of the Southern army, which he found on his arrival, in December, in a state of utter disorganization and want. He soon advanced to a well-chosen camp on the banks of the Pedee, and began a series of operations which in less than a year stripped the enemy of nearly all their hard-won conquests in the two Carolinas and Georgia, and shut them up within the narrow limits of Charleston and its immediate neighborhood. Among the events of this active year were the battle of the Cowpens, won by Gen. Morgan at the opening of the campaign; a brilliant retreat from the Catawba

to the Dan; the battle of Guilford Court House, in which he lost the field, but gained the end for which he fought; the pursuit of Cornwallis to the Deep River; the daring advance into South Carolina; the battle of Hobkirk's Hill, a second defeat followed by the results of victory; the siege of Fort Ninety-six, raised by the advance of Lord Rawdon, but followed by the immediate evacuation of the post and the retreat of the enemy toward the west; the drawn battle of Eutaw Springs, and the advance upon Dorchester, spoken of by Washington as another "proof of the singular abilities" of Gen. Greene. Congress presented him with a medal for services in the battle of Eutaw Springs, and North and South Carolina and Georgia made him valuable grants of property. He removed to the estate of Mulberry Grove, on the Savannah River, Georgia, where he died of a sunstroke. Greene was a brilliant soldier, energetic, watchful, and strong in emergency. He was also much of a diplomat in persuading Congress of the necessities of the army, and in levying troops in a district not wholly favorable to the patriot cause. Consult: G. W. Greene, 'Life' (1867–71); F. V. Greene, 'General Nathanael Greene' (1893).

Greene, Nathaniel, American journalist: b. Boscawen, N. H., 20 May 1797; d. Boston, Mass., 29 Nov. 1877. At 12 he entered the office of the 'New Hampshire Patriot,' published at Concord, and at 15 became editor of the 'Concord Gazette.' After editing papers at Portsmouth, N. H., and Haverhill, Mass., he removed to Boston, where he established a new Democratic paper known as the 'Boston Statesman,' and published semi-weekly, its first appearance being on 6 Feb. 1821. During the administration of J. Q. Adams it was opposed to the almost unanimous sentiment of the city and State; but in 1829, when the general government passed into the hands of the Democratic party, President Jackson appointed Greene postmaster of Boston. He held the office for 12 years without interruption, and, although removed in 1841, was reappointed to it by President Tyler in 1844, and held it until 1849. In 1836 he translated a 'History of Italy' from the Italian of Sforzozi, which was followed by the translation of two volumes of 'Tales from the German' (1837). In 1843 he published 'Tales and Sketches from the French, German, and Italian.'

Greene, Samuel Dana, American naval commander: b. Cumberland, Md., 11 Feb. 1840; d. Portsmouth, N. H., 11 Dec. 1884. Graduated at the Naval Academy in 1859, he volunteered in January 1862 to serve as executive officer of the Monitor, whose capabilities were then untested, and during the engagement of the Monitor with the Confederate ram Merrimac, in Hampton Roads, he commanded the vessel on account of an accident to Captain Worden, his superior. After the war he was a professor at the Naval Academy for 10 years.

Greene, Sarah Pratt McLean, American novelist: b. Simsbury, Conn., July 1856. She was educated at South Hadley Seminary, and for several years taught school in Plymouth, Mass. In 1887 she was married to F. L. Greene. She has published 'Cape Cod Folks,' which achieved wide notoriety through the author's use of the names of living people for her characters, and the consequent lawsuits in which the publishers were involved (1881); 'Towhead, the Story of a Girl' (1884); 'Lastchance Junction' (1889); 'Leon Pontifex' (1897); 'The Moral Imbeciles' (1898); 'Vesty of the Basins' (1900)

Greenfield, Ind., city, county-seat of Hancock County, on the Pittsburg, C., C. & St. L. R.R., 20 miles east of Indianapolis. It has foundries, machine shops, and manufactures of glass, paper, stoves, etc. It is the birthplace of James Whitcomb Riley (q.v.). Pop. (1900) 4,489.

Greenfield, Iowa, town, county-seat of Adair County, on the Chicago, B. & Q. R.R.; 130 miles southeast of Sioux City. It is the commercial centre of a farming district. Pop. (1900) 1,300.

Greenfield, Mass., town, county-seat of Franklin County; on the Connecticut River, the Boston & M. R.R.; about 34 miles north of Springfield. Greenfield was once a part of Deerfield; but in 1738 it petitioned for a separation, which was not granted until 1743. Greenfield and vicinity has many famous historic associations. The massacre of Deerfield occurred in the winter of 1704, and a monument marks the place where an Indian struck down Eunice Williams, the wife of the parson, John Williams, on 1 March 1704. She was one of the 112 captives the Indians had started on the 300-mile march to Canada. Captain Turner was killed fighting in Indian battle, in the Greenfield Meadows. Agrippa Wells, a blacksmith, a brave captain in the War of the Revolution, was a resident of Greenfield. In 1903 the town celebrated her 150th anniversary. The chief manufactures are machinery, cutlery, shoes, paper, boxes, wooden-ware, bricks, toys, children's carriages. Pop. (1900) 7,927.

Greenfinch, or **Greenlinnet,** one of the most common and beautiful of European finches (*Ligurinus chloris*). The general color of the male is olive-green; primaries grayish-black, with bright yellow edges; under parts yellow; female brownish. Although its song is uninteresting it is a favorite cage-bird in Germany.

In Texas a greenish towhee bunting (q.v.) is locally called "greenfinch."

Greenhalge, grēn'halj, **Frederick Thomas,** American politician: b. Clitheroe, England, 1842; d. March 1896. His parents emigrated to the United States in his early years, and after completing his education by studying at Harvard for three years, he entered the Confederate commissariat department, was invalided, returned north, studied law, and was called to the bar in 1865. He was a popular governor of Massachusetts from 1894 till his death.

Greenhouse, any glass-roofed house used for plant growing. The term excludes cold frames and hot-beds, but in America includes many structures known in Europe by special names such as stove-houses, graperies, conservatories, etc. Greenhouses may be divided according to the temperature maintained in them; for example, cool-house, used for such plants as violets, pansies, daisies, etc.; conservatory, used for plants displayed but not propagated or forwarded in growth; the forcing house, in which plants are rapidly pushed

1. Blue Passion-flower (P. cœrulea). 2. Pomegranate, with opened fruit and flower. 3. An Orchid (Cattleya). 4. Abutilon (A. insigne). 5. Monkshood (Tropælium).
6. Anthurium (A. scherzerianum). 7. Begonia (B. boliviensis). 8. Pitcairnia (P. furfuracea). 9. Ladies' Slipper (Cypripedium venustum).

to marketable condition; the warm-house, used for tropical and heat-loving plants. Then there are houses designed for special crops and known as rose-, carnation-, palm-, orchid-, asparagus-houses, etc.

Since the beginning of the 19th century, and especially during the latter half, improvements in greenhouse construction, heating, ventilation, and management have made remarkable progress. In place of the heavy shade-casting roof of large wooden rafters and small panes is the large-paned, small iron-raftered roof; steam and hot water have supplanted the old flue systems; and the carefully pitched roof which favors the entrance of light in winter and not in summer, has replaced the roof of scarcely considered slant. Much attention is also given to location, some points considered being exposure to the sun, shelter from prevailing winter winds, adequate water supply, proximity to market, etc.

An idea of the importance of greenhouses may be gained from the knowledge that during the first quarter of the 19th century there were almost no greenhouses except the few cumbersome ones upon some private places, and that in 1899 there were about 9,000 commercial florists' establishments averaging about 2,500 square feet, valued at 50 cents a square foot, and a producing capacity of $1.00 a square foot — totals of $11,250,000 and $22,500,000, respectively. Besides these are hundreds of private establishments, many of which would have been considered very extensive as commercial houses 75 or even 50 years ago.

Consult: Taft, 'Greenhouse Construction' (New York 1893); Leuchars, 'Hot-Houses' (1850); Hunt, 'How to Grow Cut Flowers' (Terre Haute, Ind., 1893); Taft, 'Greenhouse Management' (New York 1898); Scott, 'Florists' Manual' (Chicago 1899); Bailey, 'Forcing Book' (New York 1897); *id.*, 'Cyclopedia of American Horticulture' (New York 1900–02).

Greenhouse Insects. Plants cultivated under glass are as subject to insect depredations as are those growing in the garden and orchard, unless the greatest care is exercised. In addition to many species of foreign origin, such as numerous kinds of scale-insects (q.v.) and aphides which are constantly being imported with exotic plants, we have native insects firmly established as indoor pests. One of the commonest and most destructive is the black scale (*Lecanium oleæ*), which is also a pest of importance in groves of citrus fruits and olives. The related hemispherical scale (*Lecanium hemisphæricum*) is still more distinctively a greenhouse pest; and several injurious orchard scales and mealy bugs (q.v.) are likely at any time to become so, but all may be controlled by fumigation with hydrocyanic-acid gas. The "white fly" (q.v.), which name, as used by florists, covers a number of species of *Aleyrodes*, is to be similarly treated.

Many plants grown artificially are attacked also by omnivorous greenhouse pests, such as the red spider (*Tetranychus bimaculatus*) and the greenhouse leaf-tyer, and by general field and garden pests such as cutworms, wireworms, and white grubs (qq.v.). The greenhouse leaf-tyer (*Phlyctænia ferrugalis*) is less affected by fumigation than most insects, and, with other caterpillars, can be successfully controlled only by hand-picking, clipping off and destroying the affected leaves, and by spraying with arsenical mixtures.

Roses are peculiarly subject to insect injury, and there are several specific indoor rose pests, such as Fuller's rose beetle (*Aramigus fulleri*), which also attacks azaleas, begonias, lilies, primrose, geranium, canna, and others. It appears to be nearly immune to insecticides in the adult condition; one must, therefore, employ hand methods, collecting and destroying the beetles, preferably in November and December, when they congregate on various plants. Injured plants should be pulled out, and the larvæ about them destroyed with kerosene emulsion or bisulphid of carbon. Numerous leaf-rollers, budworms, and leaf-tyers (qq.v.) are very injurious to the rose, by eating into the buds just before blossoming. Roses are seriously injured at times by gall-flies and by the rose-scale (*Aulacaspis rosæ*), and other scale insects. Violets cultivated under glass are much injured by insect pests, principally by the black or brown aphis (*Rhopalosiphum violæ*), violet gall-fly (*Diplosis violicola*), violet saw-fly (*Emphytus canadensis*), and the red spider, and greenhouse leaf-tyer. The black aphis is still restricted and dependent on commerce for carriage from one greenhouse to another, but has caused losses of thousands of dollars to single firms. It may be controlled by fumigation with hydrocyanic-acid gas, which also destroys the saw-fly and the gall-fly (properly a gall-gnat, q.v.), which attacks the leaves while they are young, the larva or maggot developing in folds, incorrectly termed "galls." Tobacco preparations and bubach insect-powder are also useful against these minute pests.

Green'land, an extensive island belonging to Denmark; on the northeast of the continent of North America, from which it is separated by Davis Strait, Baffin Bay, and Smith Sound; area 46,740 square miles. A great part of its north and precipitous east coast is yet unknown; but it does not extend farther than about lat. 83° N. Like the northern parts of North America generally, Greenland is colder than the corresponding latitudes on the eastern side of the Atlantic. In June and July the sun is constantly above the horizon, the ice on the coast is broken up and a few small lakes are opened; but the short summer is followed by a long and dreary winter. The interior, which is lofty, is uninhabitable, and all the villages are confined to the coasts, which are lined with numerous islands and deeply penetrated by fiords. The Danish colony extends to the Bay of Disco, in lat. 69° N. Cultivation is confined to the low shores and valleys, where grassy meadows sometimes occur with stunted shrubs and dwarfed birch, alder, and pine trees. Attempts to raise oats and barley have failed, but potatoes and turnips attain the size of a pigeon's egg, and cabbages grow very small. The radish is the only vegetable which grows unchecked.

The inhabitants of Greenland (see ESKIMOS) are of the Eskimo race, more or less mixed with European blood. The individuals of the mixed race hardly differ as to language and habits from the genuine Eskimo. Besides the natives, about 250 Europeans usually reside in the country, 30 to 40 of whom have married native women. The inhabitants are largely dependent on hunting and fishing. Whale blubber and seal oil

are used as fuel. The land animals are the Eskimo dog, the reindeer, the polar bear, the Arctic fox (blue and white), the ermine, the Arctic hare, and the musk ox. Among the amphibia the walrus and several species of seal are common. The seas abound in fish, the whale and cod fisheries being of special importance. Seafowl are abundant in summer, and largely killed. The chief mineral product is cryolite, but graphite and miocene lignitic coal are also found. Oil, eider down, furs, and cryolite are exported. For administrative purposes Greenland, or rather its coast, is divided into two inspectorates of North and South Greenland. The residences of the inspectors are at Disco Island and Godhaab, but the most populous district is Julianehaab.

Greenland was discovered by an Icelander named Gunnbjörn about 876 or 877, and was colonized from Iceland about the end of the 10th century. In the reign of Elizabeth Frobisher and Davis rediscovered the coast, but nothing was done to explore it till the Danish government in 1721 assisted Hans Egede, a clergyman, to establish a European mission settlement. Good Hope (Godhaab), which was successfully carried on by him and his son. Whale fisheries were established on the coast by the English and Dutch about 100. The interior of the country was first crossed by Nansen in 1888. There are 12 chief stations for trading and the Danish Mission; the southernmost is Julianthaab, the northernmost Upernavik. At Godhaab there is a seminary for training native catechists; of late, too, natives have been appointed pastors. Pop. (1901) 67,681.

Greenland Whale, or **Bowhead,** the largest and most restricted of the "right" or whalebone whales of the genus *Balæna* (*B. mysticetus*), which is absolutely confined to the arctic region, reports of its occurrence on other coasts originating in mistaking for it the almost cosmopolitan southern right whale. It grows occasionally to a length of 70 feet, but is usually considerably less; and is black, except a white patch on the under side of the jaw. This whale may yield 275 barrels of oil, and 3,000 pounds of whalebone. It has become comparatively rare through constant pursuit. Its general habits agree with those of its family (*Balænidæ*), for which see WHALEBONE WHALES.

Greenleaf, Simon, American jurist: b. Newburyport, Mass., 5 Dec. 1783; d. Cambridge, Mass., 6 Oct. 1853. He commenced the practice of law in 1806 at Standish, afterward practising at Gray and Portland. He was a reporter of the Supreme Court 1820–32; professor of law at Harvard University 1833–48, succeeding Judge Story in the Dean professorship in 1846; and upon his resignation in 1848 was made professor emeritus. Beside nine volumes of reports of the Maine Supreme Court proceedings he published: 'Treatise on the Law of Evidence' (1842–53); 'Principles of Freemasonry' (1820); 'Examination of the Testimony of the Four Evangelists by the Rules of Evidence, as administered in Courts of Justice, with an Account of the Trial of Jesus' (1846). He also edited Cruise's 'Digest of the Laws of England respecting Real Property' (1849).

Greenlings, a family (*Hexagrammidæ*) of coast-fishes allied to the rose-fishes, many species of which occur abundantly from northern California to Bering Sea, including several excellent and of local importance as food-fishes. They are brilliant in color, yellow and green being prominent; are carnivorous; and seek their food among kelp and about rocks.

Greenock, grĕn'ŏk, Scotland, in Renfrewshire, on the south shore of the Firth of Clyde, 22½ miles by rail west-northwest of Glasgow. The Watt Institution contains a marble statue of Watt by Chantrey. The harbor works date from 1707, and have cost upward of $7,-500,000. Ship-building has been carried on since 1760; sugar refining began in 1765, and there are also manufactures of steam-engines, anchors and chain cables, ropes, sailcloth, paper, wool and worsted, etc. Besides being the birthplace of James Watt (q.v.), famous because of his work on steam-engines, of Spence the mathematician, and of Principal Caird, it has memories of Rob Roy, John Wilson, and Galt, and contains the grave of Burns' "Highland Mary." Pop. (1901) 67,645.

Gree'nockite, or **Cadmium Blende,** a native sulphid of cadmium, having the formula CdS, and crystallizing in hemimorphic forms belonging to the hexagonal sytem. It is transparent, or nearly so, and yellow, with a vitreous or resinous lustre. It turns carmine when heated in a closed tube, returning to its original color upon cooling; and it dissolves in hydrochloric acid, with liberation of sulphuretted hydrogen. Greenockite is brittle, and has a hardness of from 3 to 3.5, and a specific gravity of about 5.0. In the United States it is found in Marion County, Ark., in the zinc-bearing districts of southwestern Missouri, and in a zinc mine in Lehigh County, Pa.

Greenough, grēn'ō, **Horatio,** American sculptor: b. Boston 6 Sept. 1805; d. Somerville, Mass., 18 Dec. 1852. When he entered Harvard at 16 he had already modeled in clay and attempted sculpture. A French sculptor named Binon, resident in Boston, was his first master. During his college career he enjoyed the friendship and advice of Washington Allston, and produced the design from which the present Bunker Hill monument was erected. He was graduated in 1825, and went to Rome with letters to Thorwaldsen. He returned to Boston in 1826, and after modeling busts of John Quincy Adams, Chief Justice Marshall, and others, again went to Italy and established his studio in Florence. His first commission was from James Fenimore Cooper, for whom he executed his 'Chanting Cherubs,' suggested by a portion of one of Raphael's pictures. This was the first original group from the chisel of an American sculptor. To Cooper, also, he was indebted for the commission from Congress to execute his colossal statue of Washington, finished in 1843, after many years' labor, and now in the national capital. During this time he executed, among other original works, the 'Medora,' the 'Angel Abdiel,' and the 'Venus Victrix' (Gallery of the Boston Athenæum). In 1851 he returned to the United States to superintend placing in its destination in Washington his group of the 'Rescue,' in which the triumph of civilization is symbolized. Many vexatious delays prevented the arrival of the work from Italy, and Greenough, unaccustomed by long absence to the turmoil of American life, and the variations of the American climate,

was attacked by brain fever, soon after he had commenced, in Boston, a course of lectures on art. He published a volume of 'Essays' on art topics. Consult: Tuckerman, 'Memorial of Horatio Greenough' (1853).

Greenough, James Bradstreet, American Latin scholar: b. Portland, Me., 1833; d. Cambridge, Mass., 11 Oct. 1901. He was graduated from Harvard College in 1856, for some time practised law in Michigan, in 1865 was appointed tutor in Latin at Harvard, in 1874 assistant professor of Latin, and in 1883 professor. In 1872 he began at Harvard a course in Sanskrit and comparative philology, and until 1880, when a chair of Sanskrit was founded, gave instruction in those subjects. He became widely known through a series of Latin text-books, particularly a 'Latin Grammar,' prepared in collaboration with J. H. Allen; and wrote also a 'Special Vocabulary to Virgil' verse in both Latin and English, and, with G. L. Kittredge, 'Words and Their Ways in English Speech' (1901).

Greenough, Richard Saltonstall, American sculptor: b. Jamaica Plain, Mass., 27 April 1819; d. Rome, Italy, 23 April 1904. Among works by him are the notably fine bronze statue of Franklin in front of the City Hall, Boston; the marble statue of Governor Winthrop at Mount Auburn cemetery, Cambridge; 'The Shepherd Boy and the Eagle' at the Boston Athenæum.

Greenough, Sarah Dana Loring, American author: b. Boston 19 Feb. 1827; d. Franzensbad, Austria, 9 Aug. 1885. She was the wife of R. S. Greenough (q.v.). Her works include: 'Treason at Home,' a novel (1865); 'Arabesques' (1871); 'In Extremis, a Story of a Broken Law' (1872); and 'Mary Magdalen,' a poem (1880).

Greenport, N. Y., village of Suffolk County, on the eastern end of Long Island, on the Long Island R.R.; 90 miles east of Brooklyn. It has an excellent harbor and shipyards, and the chief industries are fishing and shipbuilding. It is also a popular summer resort. Pop. (1900) 2,366.

Greens, Pot-herbs. Any plant whose foliage and succulent stems are prepared for the table by boiling. The former term is less applied to the plants themselves than to the dish prepared from them; the latter is often applied to the living plants, but rarely to the culinary preparation. Greens are eminently a spring dish; by proper management they may be obtained long before spring-sown vegetables grow from seed planted out of doors, thus arriving at a time when the appetite is jaded with the usual winter vegetables. Comparatively few (for example, basella and New Zealand spinach) are useful during the hot summer months, but then other vegetables and many fruits take their place. Some (for example, mustard, witloof) are obtainable in the autumn, and a few (kale, endive) even during winter.

In general these plants should all be grown upon rich, moist, well-drained, friable, loamy soil, since upon such they grow quickly, to a large size, and remain succulent and edible longer than upon poorer or drier soils. A soil containing abundant available nitrogenous plant food is particularly desirable. The ground should be thoroughly prepared by deep plowing or digging and the surface made as fine as possible by harrowing or raking. For earliest crops of such hardy plants as spinach and corn salad, the seed may be sown in autumn, and, where the winters are severe, and especially if snowless, protected with a mulch of marsh hay or other material free from weed seeds. They may also be sown as early in the spring as the ground can be worked. Tender plants such as basella, and those that require a high temperature for the germination of their seeds, for instance, purslane, should be sown only after the ground becomes warm. Beyond keeping the surface of the soil loose and free from weeds, the crops need practically no further care. To be best appreciated, greens should be gathered while very succulent and within as few minutes of meal time as are possible to wash and cook them. Since most of them occupy the ground for only a few weeks in earliest spring, they are usually planted by market gardeners between the rows of other slower growing crops or as precursors to the main crop.

Besides the cultivated pot-herbs (in America a rather small list), there are several scores of plants known most widely as weeds. Several of these are superior in some ways to the cultivated kinds. There is no reason why they should not be cultivated; indeed, they deserve cultivation. When to be grown in the garden, and when seed cannot be purchased, seed should be selected from those plants that most nearly meet the intending grower's ideal. Probably the best known and most frequently used weeds or wild plants are the following, several of which are more or less cultivated: Lamb's quarters or Goosefoot (*Chenopodium album*), Pigweed (*Amarantus,* various species), Pokeweed (*Phytolacca decandra*), Marsh marigold, "Cowslip Greens" (*Caltha palustris*), Mustard (*Brassica,* various species), Dock (*Rumex,* various species), Quinoa (*Chenopodium Quinoa*), Sorrel (*Oxalis,* various species), Purslane (*Portulacca oleracea*), Plantain (*Plantago,* various species), Chicory (*Cichorium Intybus*), Cress (*Cardamine, Spilanthes, Barbarea, Senebiera, Gynandropsis, Nasturtium* — various species in each genus), Peppergrass (*Lepidium,* various species), Mercury or markery (*Chenopodium Bonus-Henricus*), Nettle (*Urtica,* various species), Winter purslane (*Montia perfoliata*), Rocket salad (*Eruca sativa*), Salad-burnet (*Porterium Sanguisorba*).

Of the cultivated pot-herbs the following are probably the best known and the most widely cultivated: Spinach, corn salad, chard, borage, dandelion, callards, mustard, kale, orach, marigold, basella, chicory, endive, nasturtium, unheaded cabbage and cauliflower, young beets and turnips, whole or only the leaves, and rape are frequently used also.

Green'sand, in geology, the name given to two series of cretaceous formations, the Upper and Lower Greensand. The Upper Greensand is a subdivision of the Upper Cretaceous rocks, and is situated immediately below the chalk marl, and just above the gault. The beds of which it is composed have in them green particles of a mineral called glauconite. Among the fossils peculiar to it are various ammonites, two pterodontas, two species of fusus, etc. Some are of opinion that the so-called Upper Greensand from which these fossils came is

itself gault. The Lower Greensand is a series of beds constituting the Lower Cretaceous rocks and the lowest member of the cretaceous group. It is called in Europe Neocomian, a name adopted by Lyell, he considering the term greensand peculiarly inapplicable, as in the district where these strata were first observed sand of a green color was rather the exception.

Greens'boro, Ala., town, county-seat of Hale County; on a branch of the Southern R.R.; about 72 miles southwest of Birmingham. It was settled in 1816, and is in a cotton-growing section. The chief industries are the cultivation of cotton and corn. It is the seat of Greensboro Female Academy and of the Southern University. The latter was established by the Methodist Episcopal Church, South, and was opened in 1859. Pop. (1900) 2,416.

Greensboro, Ga., city, county-seat of Greene County; on the Georgia R.R.; 70 miles west of Augusta. It is the trade centre for a thriving agricultural region, and it has a large creamery, a cotton-mill, cotton-gin, and a cottonseed-oil mill. Pop. (1900) 1,511.

Greensboro, N. C., city, capital of Guilford County, on the Southern R.R.; 81 miles northwest of Raleigh; named in honor of Gen. Greene, who commanded the Continental army in the battle of Guilford Court House 15 March 1781. Here are the Greensboro Female College, Bennett School for Colored Youth, Guilford College, and the State Normal and Industrial College. Greensboro is the centre of a tobacco, fruit, and grain region, which has gold, copper, and iron mines, and contains a blast furnace for the manufacture of Bessemer steel; cotton-mills and other industries. The growth of the city has been marvelous and shows the rapid development of the New South. Pop. (1880) 2,105; (1890) 3,317; (1900) 10,035; (1903) 22,000.

Greensboro Female College, a non-sectarian educational institution for women in Greensboro, N. C.; founded in 1826 as the Edgeworth Female Seminary; reported at the close of 1900: Professors and instructors, 15; students, 250; volumes in the library, 7,000; income, $25,000; number of graduates, 692.

Greensburg, Ind., city, county-seat of Decatur County; on the Cleveland, C. C. and St. L. R.R.; about 55 miles northeast of Cincinnati. Nearby are large stone-quarries; it is surrounded by a good agricultural region, and is supplied with natural gas. Its chief manufactures are flour, furniture, farm implements, and carriages. Pop. (1900) 5,034.

Greensburg, Pa., borough, county-seat of Westmoreland County; on the Pennsylvania R.R.; 31 miles east-southeast of Pittsburg. It is in a coal-mining, coking and natural gas region; and contains a steam-heating apparatus factory, steel works glass works, nut and bolt works, and has three National banks. It is the seat of St. Joseph's Academy. In Hanna's Town, which was near the present Greensburg, was held (1773) the first regularly organized court of justice west of the Alleghany Mountains. Hanna's Town was destroyed by the Indians in 1782. Pop. (1900) 6,508.

Green'shank, a large species of sandpiper (*Totanus glottis*) breeding in the northern parts of the Old World, and migrating far southward. Several allied species of similar habits occur in America, of which the greater and lesser yellowlegs (q.v.) are familiar to gunners.

Greens'let, Ferris, American writer: **b.** Glens Falls, N. Y., 30 June 1875. He was educated at Wesleyan University and beside contributions to reviews has published 'Joseph Glanville: a Study in English Thought and Letters of the 17th Century' (1900).

Green'stick Fracture, the name given to a fracture of a bone when continuity is not entirely severed one portion of the bone remaining unbroken or bent. The leg and arm bones of children are particularly liable to this fracture.

Green'stone, formerly a granular rock, consisting of hornblende and imperfectly crystallized feldspar, the feldspar being more abundant than in basalt, and the grains or crystals of the two minerals more distinct from each other. It was called also dolorite. Sir Charles Lyell included under the term greenstone those rocks in which augite was substituted for hornblende, the "olorite" of some writers, and those in which albite replaced common feldspar. This was sometimes termed andesite. The term is now used the same as diorite, which is an essentially crystalline granular admixture of triclinic feldspar and hornblende. It is not now held to be the equivalent of dolorite. In geology, volcanic rock, occurring in dykes, tabular masses, etc.

Green'ville, Ala., city, county-seat of Butler County; on the Louisville & N. R.R.; about 77 miles northeast of Mobile. Its chief manufactures are lumber and furniture; it has a cotton-gin, and its trade consists principally in cotton and lumber. Pop. (1900) 3,162.

Greenville, Ill., city, county-seat of Bond County; on the Vandalia & T. H., and the Louisville J. & St. L. R.R.'s; about 42 miles east of Alton. It is the seat of Greenville College, under the auspices of the Free Methodist Church. The chief manufactures are flour, lumber, wagons, and carriages, bricks, and in addition to its manufactured articles, it has considerable trade in coal, from the coal-fields of the vicinity, and in the agricultural products of the surrounding country. Pop. (1900) 2,504.

Greenville, Mich., city, in Montcalm County, on the Flat River, the Toledo, S. & M. and the Pere M. R.R.'s; about 42 miles northeast of Grand Rapids. Its chief manufactures are lumber, flour, agricultural and lumbering implements, refrigerators and furniture. Its trade is in its own manufactured products and in the agricultural products of the surrounding country. Pop. (1900) 3,381.

Greenville, Miss., city, county-seat of Washington County; on the Mississippi River, the Southern and the Yazoo & M. V. R.R.'s; about 139 miles south of Memphis. It contains several cottonseed-oil-, saw-, and planing-mills, a national bank, and has steamboat connection with all important ports on the river, and a large cotton trade. Pop. (1900) 7,642.

Greenville, Ohio, city, county-seat of Darke County; on Greenville Creek, and the Cincinnati, J. & M. the Dayton & U., and the Pittsburg, C., C. & St. L. R.R.'s; 35 miles north of Dayton. It is noted as the site of Anthony Wayne's treaty with the Indians, 3 Aug. 1795.

In the early part of the 19th century Tecumseh (q.v.) lived here, in a little Indian village. It has a foundry, lumber mills, and machine shops, and is the trade centre for a large agricultural section. Pop. (1900) 5,501.

Greenville, Pa., borough, in Mercer County; on the Shenango River, the Erie, the Pennsylvania, and the Pittsburg, B. & L. E. R.R.'s; about 52 miles southeast of Erie. The Shenango furnishes an abundance of good water-power. The chief industrial interests are flour-mills, woolen-mills, saw- and planing-mills, foundries, machine-shops, railroad-shops, carriage and wagon works, tube-mills, machinery for oil-wells, and coal-mining. The coal and oil fields and the stone-quarries in the vicinity add to the industries of the town. The trade of the town is considerable, as it is the commercial centre of a large section of Mercer County and places nearby in Ohio. Greenville was formerly the seat of Thiel College, opened in 1870 under the auspices of the Lutheran Church. Pop. (1890) 3,674; (1900) 4,814.

Greenville, S. C., city, county-seat of Greenville County; on the South Carolina & G., the Southern, the Atlantic C. L. R.R.'s.; 153 miles northwest of Columbia. It is the seat of Furman University (Baptist), Greenville College for Women, Chicora Female College (Presbyterian), Greenville Female College (Baptist), a military institute, and a business college. It has cotton mills, carriage and wagon works, iron works, and flour mills. Pop. (1900) 11,860.

Greenville, Texas, city, county-seat of Hunt County; on the St. Louis Southwestern, the Texas Midland, and the Missouri, Kansas & Texas R.R.'s; about 235 miles north of Houston and 51 miles northeast of Dallas. Greenville was settled in 1844 and incorporated in 1875. It is situated in an agricultural and stock-raising section. The chief industrial interests are connected with cotton and live stock. It has cotton-compresses, cottonseed-oil mills, flour mills, machine-shops, stock-yards, and brick-yards. It is the trade centre for a large extent of country and has a large cotton trade. It is the seat of Burleson College, under the auspices of the Baptist Church, and of Holiness College. Its executive officers are a mayor and a municipal council who hold office for two years. The electric-light plant is owned and operated by the city. Pop. (1890) 4,330; (1900) 6,860.

Greenville (Ohio), **Treaty of,** 7 Aug. 1795. A treaty between the United States and all the Northwestern Indian tribes; the former represented by Anthony Wayne, who had defeated the Indians in the campaign of 1794, especially at the battle of the Fallen Timbers (q.v.). A full delegation was present from every hostile tribe, the whole numbering 1,130. They surrendered to the whites all southern Ohio and southeastern Indiana, with lands around Fort Wayne, Fort Defiance, Detroit, Michillimackinac, and the French towns, and 150,000 acres near the Falls of the Ohio (Louisville) which had been allotted to George Rogers Clark and his soldiers. The United States acknowledged the Indian title to the remaining territory, and agreed to pay annuities of $9,500 in all to the tribes. All prisoners on both sides were restored. This peace secured quiet to the borders for 15 years. But the guaranty of the lands to the Indians enabled the British to use the latter to desolate the borders in the War of 1812; and after the war (see TREATY OF GHENT) Great Britain attempted to make this treaty boundary a permanent one, forbidding United States settlement beyond it. See GREENVILLE, O.

Greenway, Thomas, Canadian statesman: b. England, 1838. In 1844 he came with his father to Ontario. He took up land in Manitoba, and in 1887 became the Liberal leader and Prime Minister in the provincial government, when his party came into power in 1888. He has always studied the well-being and progress of his province; has attempted to abolish French as an official language, and to do away with the separate school system.

Greenweed. See DYEWEED.

Greenwich, grēn'wĭch, Conn., town, in Fairfield County, on Long Island Sound, the New York, N. H. & H. R.R., about 28 miles northeast of New York. The town was founded in 1640, as a part of the province of New York, and remained within the jurisdiction of the Dutch colony from 1642 to 1650, when, by agreement between the English and Dutch, it became a part of Connecticut. In order to preserve the charm of its country life, it has retained the old form of town meeting government, with three selectmen as agents, as it was over 250 years ago, except in the central part of the town, where a borough government, a warden and six burgesses, has charge of affairs. There are five residential centres within its area of 80 square miles; namely, Byram Shore, Belle Haven, Greenwich village, Riverside, and Sound Beach. It is the seat of Greenwich Academy, Brunswick School, and Rosemary Hall. Pop. (1900) 12,172. Consult: Mead, 'History of the Town of Greenwich.'

Greenwich, grĕn'ĭj, England, metropolitan borough of London, in Kent, five miles from St. Paul's Cathedral and six miles southeast of London Bridge. It has many noted institutions, one of which is the Greenwich Royal Observatory, founded in 1675 by Charles II.; its first astronomer-royal was Flamsteed. Geographers of all countries reckon longitude from the meridian of Greenwich, although the local geography of many countries may be reckoned from their respective capitals. Greenwich Hospital, founded by Queen Mary, for disabled seamen "who protected the public safety in the reign of William and Mary, 1694," is located on the site of the palace where Henry VIII. and his daughters Mary and Elizabeth were born, and where Edward VI. died. The hospital consists of four distinct buildings, one of which was designed by Inigo Jones (q.v.), and the other three by Sir Christopher Wren (q.v.). James Stuart made the designs for the restored portion of the chapel; and the statue of George II., in the central square, is by Rysbrach. In 1873 Greenwich Hospital became the college for the Royal Navy. The Royal Hospital School for boys who may enter the navy, and the Blue-Coat School, are liberally endowed. Pop. (1901) 185,149.

Greenwood, Grace. See LIPPINCOTT, SARAH JANE (CLARKE).

Greenwood Cemetery, N. Y., the principal burial place of New York and neighborhood, in South Brooklyn, near Gowanus Bay: area 475 acres. It occupies a picturesque site, and is laid out so handsomely as to make it almost without a rival in the world. From its heights the waters of New York Bay may be seen on the one hand, and the broad expanse of the Atlantic on the other. There are 20 miles of roadway and more than 25 miles of footpaths. Many distinguished men and women are buried here. The main gateway is adorned with four magnificent sculptures in *alto relievo*, representing four scenes in the resurrection. The number of interments up to 1901 exceeded 300,000.

Greer, David Hummell, American clergyman: b. Wheeling, W. Va., 20 March 1844. He was graduated from Washington College, Washington, Pa., in 1862, and studied theology in the Episcopal Seminary at Gambier, O. From Brown University and Kenyon College he received the titles of Doctor of Divinity and Doctor of Laws. His first ministry was at Covington, Ky.; from there he was transferred to Clarksburg, W. Va., and in 1871 he was called to Grace Church, Providence, R. I. In 1885, Dr. Greer became rector of St. Bartholomew's Parish, the most fashionable and richest of New York Episcopal parishes. In 1890 he established the St. Bartholomew's Parish House, at 42d street and 3d avenue, at a cost of $400,000, built largely through the liberality of Cornelius Vanderbilt. This parish house embraces a wide field of charitable, missionary and educational work.

In 1903 Dr. Greer was elected coadjutor to Bishop Potter of the New York Episcopal diocese. He had previously declined three bishoprics, that of coadjutor-bishop of Rhode Island, bishop of Pennsylvania, and bishop of Massachusetts to succeed Phillips Brooks.

Greer, James Augustin, American rear-admiral: b. Cincinnati, O., 28 Feb. 1833; d. Washington, D. C., 17 June 1904. Entering the navy in 1848, he was promoted lieutenant in 1855, and was on board the San Jacinto when that vessel intercepted the English steamer Trent, on which were Mason and Slidell, the Confederate commissioners. He commanded the ironclad Benton in the fleet that passed the Vicksburg batteries; and in 1873 was in command of the Tigress in its search of the polar seas for the Polaris. He became rear-admiral in 1892 and was retired in 1895.

Greey, grē, **Edward,** American writer: b. Sandwich, Kent, England, 1 Dec. 1835; d. New York 1 Oct. 1888. After spending several years in Japan, he came to the United States in 1868, became a citizen, and engaged in commercial pursuits in New York. He published 'Young Americans in Japan' (1881); 'The Wonderful City of Tokio'; 'The Golden Lotus' (1883); 'The Captive of Love,' founded on a Japanese romance; 'The Loyal Ronins,' a translation from the Japanese, etc.

Greg'arine, a parasitic sporozoan (see SPOROZOA) dwelling in the intestines of many insects, crawfishes, and other arthropods.

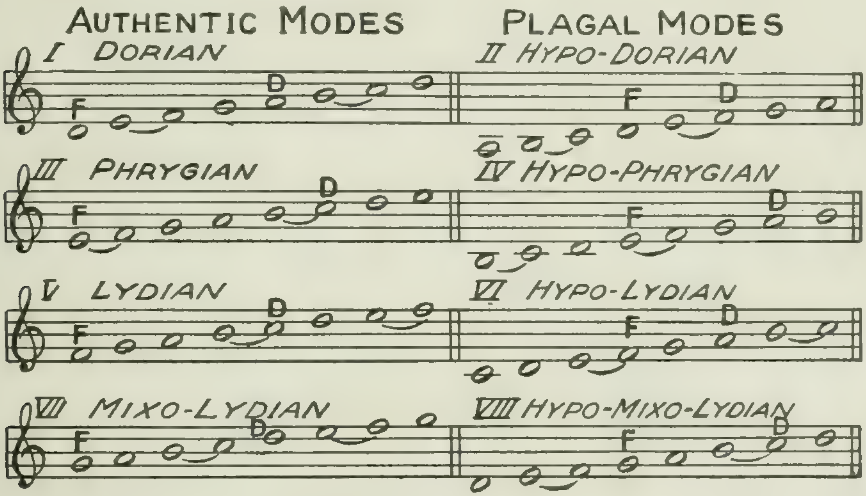
Gregg, David, American Presbyterian clergyman: b. Pittsburg, Pa., 25 March 1846. He was graduated at Washington and Jefferson College in 1865. He has been pastor in several places, and since 1889 has preached in Lafayette Avenue Presbyterian Church, Brooklyn, N. Y. He is editor of 'Our Banner,' and among his many published volumes may be mentioned: 'Makers of the American Republic' (1896); 'Ideal Young Men and Women' (1897); 'Facts that Call for Faith' (1898); 'Things of Northfield and Other Things' (1899).

Grégoire, Henri, ŏṅ-rē grā-gwär, COUNT, French churchman and statesman: b. 4 Dec. 1750; d. Paris 28 May 1831. In 1789, while cure of Emberménil, in the district of Nancy, he was sent by the clergy of Lorraine as their representative to the States-General. As one of the secretaries of the constituent assembly he joined the extreme democratic section, and in the convention voted for the condemnation, though not for the death, of the king. Although extreme in his democratic opinions, he was an unflinching Jansenist. He was a member of the Council of Five Hundred, of the corps législatif, and of the senate (1801). On the conclusion of the concordat he resigned his bishopric of Blois. He voted against the establishment of the imperial government, and alone in the senate resisted the restoration of titles of nobility. He himself afterward accepted the title of count, but in the senate always opposed Napoleon, and in 1814 was one of the first to vote for his deposition. He left numerous works, among them 'Ruines de Port Royal' (1801); 'Essai Historique sur les Libertés de l'Eglise Gallicane'; 'Historie des Sectes Religieuses depuis le Commencement de ce Siècle'; 'Annales de la Religion' (1795–1803).

Gregorian Chant (Latin, *cantus gregorianus, cantus planus, cantus firmus;* Italian *canto fermo;* French, *chant gregorien, plainchant;* German, *gregorianischer Choral*) is as old as the Church itself. As an integral part of the liturgy, music has its origin in the celebration of the Last Supper. According to the evangelists, Matthew and Mark, after the consecration and breaking of bread, our Lord and the apostles *sang* a hymn, which is commonly accepted to have been the "Great Hallel" of the Jewish passover celebration, that is, the Psalms, cxii.–cxvii. (Douai version), inclusive. The first Christian communities of Jerusalem in Palestine and Antioch in Syria were founded by newly converted Jews. Consequently it is more than probable that, although the converts from paganism were soon in the majority, melodies in use in the temple and in the synagogues continued to be sung at their religious meetings. This hypothesis is all the more reasonable because the recruits from paganism could offer nothing either in the way of poetry or music which would have been acceptable to the new cult. As to how the chant came to Rome and concerning its early development, archæology has so far been unable to ascertain any definite information. Conjecture and probability are the most we have to go by. Without doubt Greek music, which was known to the Romans, as was every other form of Hellenic culture, had its influence on the formation of the Christian worship music. It is certain also that there was a constant development and that singing played an ever greater role in the early liturgy. There were hardly any religious functions of which the singing of psalms, responsories and hymns did not form a part. From the fruitful soil of

the early Church sprang with great exuberance a new hymnology, which in turn, as its logical complement, was translated into melodies. Many of the latter were spontaneous improvisations, the children of ardent hearts and imaginations illumined by the New Light. At first the whole religious community participated in the singing, but as the liturgy became more elaborate and the assemblies more numerous, this participation on the part of all the faithful had to be restricted to certain portions of the service. Other, more particular parts were performed by the Primicerius, Præcentor or Monitor, who also had general charge of the singing and whose office it was to see that the faithful were well prepared for their allotted task. After emerging from the catacombs at the beginning of the 4th century the Church displayed its ever-growing vitality in the unfolding of her liturgy and the increasing splendor of her cult. At this period the chants used must have been numerous and varied. Popes and bishops fostered the liturgical music in every manner. Pope Sylvester (314) and Hilarius (461) founded schools for its cultivation. Saint Ambrose, Archbishop of Milan (397), took a step which was of greater importance than anything which had been done up to that time. He gave system and order to the melodies and chants in use in his archdiocese by giving them a theoretic basis. This he accomplished by adopting four modes or scales, each one of which had as its initial one of the four notes of the Tetrachord (sequence of four notes), D, E, F, G. The four modes adopted by Saint Ambrose were consequently: (*a*) (Dorian) D, E,F, G, a, b,c, d; (*b*) (Phrygian) E,F, G, a, b,c, d, e; (*c*) (Lydian) F, G, a, b,c, d, e,f, (*d*) Mixo-Lydian), G, a, b,c, d, e,f, g. All the melodies and chants used had some one of these modes for their foundation. Saint Ambrose originated the custom of singing hymns and psalms antiphonally.

When 200 years later, Gregory the Great, the man who gave the music of the Church its permanent character and from whom it is named, ascended the papal throne, the number of feasts and consequently of liturgical chants had increased to such an extent that the four modes fixed by Ambrose were no longer sufficient. Many of the new melodies did not belong to any one of the scales enumerated above. They had grown beyond the original frame. As Gregory partly reformed and, at least in outline, gave shape to the ecclesiastical year as we now know it, he was compelled also to rearrange existing chants, reject inferior ones, adapt old ones to new texts and add new ones of his own creation. In order to carry out this vast plan he found it necessary to enlarge the tonal system then in use. He retained the four Ambrosian modes, which were henceforth designated as the *authentic* modes, and added thereto four more which he called *plagal*. Gregory formed the new modes by transposing the last four notes of the existing — authentic — scales an octave lower, so that each plagal mode began a fourth below the *authentic* from which it sprang. Thus the tonal system as completed by Saint Gregory was as follows:



[N. B.— The letters F and D in the above diagram stand respectively for *final* and *dominant*. The *final* is the tone on which a melody finds repose, or a satisfactory ending. As will be observed, the *final* for any given authentic mode and its derived plagal are identical. The *dominant* is that tone which occurs oftenest or predominates in any melody.]

Four more modes were added to these in later centuries, but they are not different in essence from the eight named above. By means of various signs — dots, strokes, bars or hooks, collectively called neums — all of which had a conventional meaning, and which were placed over and alongside the words of the texts, Saint Gregory indicated the melodies to which these texts were to be sung. The book containing the chants for the numerous offices was called "antiphonarium cantorum." It was deposited near the altar of St. Peter so as to convey that the pontiff wished it to be considered as the norm for the whole Christian world.

In order to gain an insight into and an appreciation of the nature and character of the Gregorian melodies, it will be well to examine a little more closely the tonal material out of which they are constructed. We will notice that all the scales are diatonic, that is to say

that each one has five whole tones or steps and two half-steps or semi-tones; furthermore that the half-steps or semi-tones occur in a different place in each scale, according to what the initial note happens to be, and, finally that only one of them has a *leading tone* or half-step between the seventh step and the octave or repetition of the initial note. It is these three features which differentiate the Gregorian modes so markedly from our modern scales and which give them that impersonal and objective character so marvelously suited to the purpose they serve, namely, that of expressing the ideas and sentiments conveyed by the sacred texts. In other words, these modes, or tonalities, lend themselves to the expression of a mental attitude of objectivity as against the modern scales which, on account of their chromatic character, are more pliable vehicles for conveying the emotions springing from subjectivism and introspection. If we remember, in addition to the general character of the Gregorian, or Church modes — as they are often called — the rule which permits the use of six intervals only in the formation of Gregorian melodies, namely: the major and minor second, the major and minor third, the perfect fourth and the perfect fifth, we realize that this tonal system is better adapted for the expression of reverence, humility, peace, and joy, whereas the modern chromatic system is more suited for the expression of passion and dramatic conflict.

Saint Gregory used every means at his command to propagate the chant and have it universally adopted. He established schools for its proper interpretation. At one of these he is said to have taught in person. Missionaries who were sent from Rome into foreign lands took with them a copy of the antiphonarium, and, of course, a knowledge of how the melodies it contained should be sung. Thus, Saint Augustine brought the melodies to England at the command of St. Gregory himself. The great pope's successors continued the process of propaganda during the following centuries. In the 8th century Saint Boniface introduced the chant in Germany, and by him several "scholæ cantorum" were established on German soil. Through Pepin and after him through Charlemagne, it found its way into Gaul and into the whole territory under the emperor's sway.

It is held by many historians that the original chant was, in the main, syllabic, that is to say, that only one note was sung to each syllable and that only the word "alleluja" was ever extended over several notes. Be that as it may, it is certain that it gradually developed into a melismatic system, syllables being often extended over smaller and greater groups of notes.

From the time of Saint Gregory until the advent of Guido d'Arezzo (995–1050?) the primitive means of determining the melody, the neums described above, remained in use. As has been pointed out, these signs were intended to assist the memory of the singers in reproducing the melodies which they had learned by oral transmission. It is not to be wondered at that, in the course of time, many of the melodies were altered and modified in the many places where they were in use. There were frequent variations and modifications due to local habits, different temperaments, but, above all, to the insufficiency of the means employed to indicate with precision the form of the melodies. Careless copyists and finally the arbitrariness and caprice of singers in the various countries led to confusion. Before the time of Guido d'Arezzo, attempts had been made to fix with more precision the intervals of the melodies. He found in use two lines, a red and a yellow one, drawn across the page. Upon the red line was placed the F, and C was put upon the yellow one. Above, below and between these two lines the neums were written. By placing a black line between the two already existing and adding another above or below these three as the *ambitus* or range of the melody might require, Guido created the four line staff which has been used ever since for the chant, and made it possible to indicate precisely the form of a melody for all time to come. Guido and his pupils transcribed the existing chants into the new system of notation. Copies of these transcriptions found their way into the cathedrals and monasteries of many countries where they took the place of the books formerly in use. Though the neums as a *system of notation* were superseded by the more precise invention of Guido, they continued nevertheless to be employed to indicate the manner of *interpretation*. Although Guido's invention was epoch-making and of incalculable importance in the history of music, it must not be inferred that it was at once universally adopted. Neums as a means of notation continued in use in many places and institutions far into the 13th century. Nor must we imagine that because of the introduction of the new system of notation no further modifications of the chant took place. As new saints were canonized and new feasts instituted by the Church, offices and chants were necessarily created. Then the growing skill of professional singers gave rise, especially in the Alleluja following the gradual, to improvisations, elaborations and displays of virtuosity which often exceeded the limits of good taste and appropriateness.

As the melodies comprising ecclesiastical music grew out of the sacred texts and were never performed without being wedded to these texts, it is but natural to assume that the melodic construction partook of the rhythmical form of the texts. Especially must this have been the case when the chant was still largely syllabic. Some maintain that the ancient chant had a definite — artificial — rhythm, as in our modern music, in contradistinction to the natural, or that dictated by the rhythm of the text. Whatever the prevailing rhythm was at the beginning of the 10th century, it was now to undergo a gradual change. The monk Hucbald invented the *organum* or diaphony, that is, the practice of having a second voice sing the melody a fifth above or a fourth below the original, or add to the fifth also the octave, the first voice meantime maintaining the original melody. By this step Hucbald paved the way for the polyphony which was soon to develop and find its culmination in the wonderful creations of Palestrina and his school in the 16th century. Sulzer in his 'Allgemeine Theorie der Künste' in the article on harmony, points out that polyphony was latent in the unison singing of the Gregorian melodies by old and young, men and boys, each class of voice, soprano, alto, tenor, baritone, and bass, having a different pitch.

Hucbald's system of parallel motion of fifths and octaves was soon succeeded by attempts at contrary motion, and counterpoint as we know it, that is, point against point (or note against note) was born. To the Gregorian melody which now became "cantus firmus," that is, unchangeable melody, were added one or more others. In giving birth to the new system and continuing to be its foundation and the source whence polyphony drew its life and being, the Gregorian chant lost its most distinguishing characteristic, that is, its natural rhythm. The themes taken from the chant and used by contrapuntists as "canti fermi" were forced into the rhythmical straight-jacket. Each note of the cantus firmus had now to assume a definite value in order that the added melodies simultaneously sung might harmonize with it. Polyphony, or the new school of music, increased in favor very rapidly to the detriment of the old chant. Instrumental music, which was gradually developing, also had a deteriorating influence on the execution and cultivation of the ancient music of the Church. Counterpoint in many instances lost its original purpose and degenerated into artificiality. Composers used it to display their skill rather than to give expression to the ideas and emotions latent in and suggested by the text to which it was wedded. A reform movement toward primitive simplicity set in toward the end of the 15th and the beginning of the 16th century. The Council of Trent enacted laws concerning the abuses that had crept into the chant as well as against the extravagances which the display of skill for its own sake had brought about and which in fact almost caused the total exclusion of figured music from the Church. In a brief dated 25 Oct. 1577, Pope Gregory XIII. directs Giovanni Perluigi Palestrina and Annibale Zoilo (Palestrina was at the time director of the papal choir and Zoilo a member of the same) to revise the chants contained in the "Antiphonaria," "Gradualia," and "Psalteria," and "eliminate" therefrom "all barbarisms, obscure passages, contradictions, and superfluous additions which, through the ignorance, neglect, and also through the malice of composers, copyists, and singers, have crept into these books." A pupil of Palestrina, Giovanni Guidetti, had, a few years previously, edited the various chants for the celebrant contained in the Missal, which had been newly revised by a commission of cardinals appointed for this purpose after the Tridentine Council. Palestrina, Zoilo, and Guidetti in their labors of revision acted upon the principle which had been lost sight of for a time, but which was now generally accepted by musicians in Rome, "that the words of the texts should be sung to the notes as they ought to be spoken or declaimed without notes." This principle in its application brought into universal use the three different kinds of note-values: the longa, the brevis, and the semibrevis. The work of revision, of the Graduale only, which was continued and completed after Palestrina's death (2 Feb. 1594) by Felice Anerio and Francesco Suriano involved many excisions and abbreviations; reduced many chants which had been elaborately melismatic to a syllabic form. This revised edition derived its name "editio medicea," from the fact that it was printed by the "stamperia" or press of that name established in Rome by Cardinal Ferdinand de Medici. The Congregation of Sacred Rites, in 1595, appointed Giovanni Maria Nanino, Giovanni Andrea Dragoni, Luca Marenzio, and Fulgentio Valesio to edit, in accordance with the principles stated above, the 'Pontificale Romanum.' The revised books were now printed and published with the approbation of Pope Paul V. (1605–21) and that of the prefect of the Congregation of Sacred Rites. This approbation did not carry with it the prohibition of the use of the old, more elaborate, now called traditional, versions of the chant. No doubt because of the latitude thus permitted, the abbreviated version did not make much headway outside of the papal territory. Besides this, monody (solo singing) and the theatrical style in general came into vogue in Italy at the beginning of the 17th century. It took such a hold of public taste that even the works of Palestrina and the masters of his school were temporarily forgotten for the trashy and trivial products which now had the upper hand. This being the case with regard to the polyphonic style, it was natural that the austere, chaste, and simple Gregorian melodies should suffer even greater neglect. While in Italy and in some other parts of the world the chant was for a time neglected, there were countries, such as France, Belgium, Spain, and the Catholic parts of Holland, where it never ceased to be cultivated according either to the traditional or the abbreviated version. Many different editions came into use, notably in France, where many dioceses had their own versions. Toward the middle of the 19th century the plan entertained by Gregory XIII., Clement VIII., and Paul V., of having uniformity for the whole Catholic world in everything pertaining to the liturgy, including the chant, was revived with new vigor. Pope Pius IX., in 1868, appointed a commission to whom he entrusted the task of editing, in accordance with existing requirements, the "editio medicea," which Pius IX. and his successor, Leo XIII., repeatedly declared to be the official version of the Gregorian chant for the whole Church. During the past 30 years or more, however, archæologists — notably the Benedictines of Solesmes, A. Dechevrens, S. J. of Paris, the Belgian savant, G. A. Gevaerts, Dr. Peter Wagner of Freiburg, Switzerland, and others — have made exhaustive studies of the manuscripts dating from the 9th century (the oldest so far discovered) up to the Renaissance. The results of these studies have induced the present Pope, Pius X., to appoint (1904) a commission for the purpose of preparing what is to be called the "editio vaticana," which will embody the fruits of the researches and labors of learned men for many years past. Whatever may be the differences between this latest version and the many that have gone before, they will in no sense change the essential character of the chant. This character has its root primarily in the nature of the scales or modes used, as has been shown above, and, secondly, in the intervals in the construction of the melodies. As has been pointed out, the melodies sprang from the sacred texts of the liturgy: they were their complement and splendor. The Church has always declared the chant to be her own music par excellence. Other forms of music which she admits in her cult, the Palestrina, or polyphonic, and the mod-

ern styles, are to be judged as to their fitness in the light of the Gregorian chant, which is the norm and standard of excellence because it best expresses the attitude of prayer.

Bibliography.—Some of the works on the Gregorian chant which may be profitably consulted are: Haberl, 'Magister Choralis'; Kienle, 'Choral-Schule'; Gietmann, 'Kunstlehre' (Vol. III.); Kornmüller, 'Lexikon der Kirchlichen Tonkunst'; Gevaert, 'La Melopée Antique dans le Chant de l'Église Latine'; the Benedictines of Solesmes, 'Paléographie Musicale'; Dechevrens, Études de Science Musicale.'

JOSEPH OTTEN.

Gregorian Liturgy, the ritual which Pope Gregory I. introduced after 590 in the Roman Catholic Church in the administration of the Eucharist, as exhibited in the book entitled 'Gregorianum Sacramentarium.' St. Gregory made a new arrangement of the liturgy of Gelasius, which was previously in use, expunging from it what seemed to him useless and adding a very few new prayers. The celebration of the mass is still essentially the same as it was then.

Greg'ory, Saint, or **Gregory of Armenia,** surnamed "THE ILLUMINATOR," founder of the Armenian Church: b. Valarshabad, Armenia, 257; d. Mount Sebuh, Upper Armenia, 332. He was conveyed by a Christian nurse from his home in Armenia, when but two years old, to Cæsarea in Cappadocia to escape being slain with his family for the crime of his father Prince Auak, who had assassinated Chosrov I., king of Armenia. When he reached manhood he married a Christian lady of Cæsarea, who after bearing him two sons retired to a monastery. Thereupon Gregory entered the service of Tiridates III., son of Chosrov, who, with the help of the Romans, had recovered his father's throne. Tiridates imprisoned him for 14 years in a deep pit, for refusing to perform an act of idolatrous worship, whereupon the tyrant was punished by a horrible temper, of which Gregory cured him and converted him to Christianity. After the baptism of Tiridates Gregory was appointed bishop and patriarch of Armenia and consecrated by Leontius of Cæsarea. Tiridates established Christianity as the national religion of Armenia, a measure afterward imitated on a larger scale by Constantine the Great. Gregory spent the last year of his life in a hermitage on Mount Sebuh.

Gregory, Saint, of Nazianzus (GREGORIUS NAZIANZENIUS), Greek Church Father: b. Arianzas, near Nazianzus, Cappadocia, about 330; d. about 390. Receiving baptism, he retired for some time with St. Basil to Pontus. He began to preach in 362 and between 365 and 374, chiefly at Nazianzus. He went to Constantinople about 378 or 379 to oppose the Arians, and was appointed patriarch of that see in 380. The election was confirmed by the Council of Constantinople in 381, but during the same year he resigned and retired to his former charge of Nazianzus. We possess a number of sermons by him, a large number of letters and many poems. His eloquence is said to have placed him nearly on a level with Basil and Chrysostom. His festival is celebrated on 9 May.

Gregory, Saint, of Nyssa, Greek Church Father: b. Sebaste Pontus, about 332; d. about 398. By the influence of his brother St. Basil (q.v.), he was made bishop of Nyssa, in Cappadocia. He took a prominent part in the Councils of Constantinople from 381 to 394. He was less of an orator than Gregory of Nazianzus, but was more distinguished than any of the Greek fathers for a philosophical spirit, and for his acquaintance with the writings of the Greek philosophers. He also exhibited a liberality in his views uncommon in his day. His festival is on 9 March. His works consist of dogmatic treatises, Scripture commentaries, sermons, letters, etc.

Gregory, the name of 16 popes, as follows:

Gregory I., called the "GREAT": b. Rome about 540; d. 12 March 604. The death of his father put him in possession of great wealth, which he expended in the foundation of monasteries and charitable institutions. Disgusted with the world, he took the monastic vows himself and became a member of one of his own establishments. On the death of Pope Pelagius in 590 he was chosen his successor, an honor which he very unwillingly accepted. He displayed great zeal for the conversion of heretics, the advancement of monachism and the rigid enforcement of celibacy among the clergy; and there was nothing in which the Church was concerned that he deemed too small to lie beyond the sphere of his personal interest and action. (See GREGORIAN LITURGY, GREGORIAN MUSIC.) During his pontificate the pretension of John, patriarch of Constantinople, to the title of ecumenical patriarch, which Gregory repudiated, contributed to bring about the schism between the Greek and Latin Churches (see GREEK CHURCH). The works ascribed to him are very numerous, and have been frequently published. His genuine writings consist of a treatise on 'Pastoral Duty' (translated by King Alfred), 'Letters,' 'Scripture Commentaries,' etc. Consult: Snow, 'St. Gregory the Great' (1892); Mann, 'Lives of the Popes in the Early Middle Ages' (1903).

Gregory II.: b. Rome; d. 10 Feb. 731. He was elected pope and his pontificate is specially noticeable as forming an epoch in the progress of the territorial pre-eminence of the Roman See in Italy. Gregory II. was distinguished by his zeal for the evangelization of heathen lands; it was under his auspices that the famous Winfried or Boniface entered on his missionary work in Germany.

Gregory III.: b. Syria; d. 28 Nov. 741. He succeeded Gregory II. in 731. The encroachments of the Lombards in Italy during his pontificate became so formidable that as the eastern emperors still remained powerless or indifferent to the protection of the Italian provinces, the Romans charged Gregory to send a deputation to Charles Martel, which promised him the title of patrician and consul of Rome in return for his help against the Lombards. Charles Martel's preoccupation with the Saracens made it impossible for him to respond to this plea. But the fact that Gregory was authorized by the Roman primus to approach Charles on this subject and in this way shows how Rome was breaking away from the East, and so marks an epoch.

Gregory IV.: b. Rome; d. 27 Jan. 844. He succeeded Valentine in 828, and was greatly

esteemed for his learning and piety. During his pontificate the observance of the feast of All Saints was made general.

Gregory V.: b. Germany; d. 18 Feb. 999; sometimes styled BRUNO OF CARINTHIA. He was nephew of the Emperor Otto III. and through his influence was chosen first German pope and at the age of 24 succeeded John XV., in 996. An anti-pope, named John XVII., was set up against him by Crescentius, a consul of Rome, but was expelled by the emperor.

Gregory V., Ecumenical patriarch of the Greek Church: b. Dimitzana, Arcadia, Greece, 1739; d. Constantinople, 1821. His original name was Georgios Angelopulus, and he took his ecclesiastical name on entering the monastery on Mount Athos where he received his theological training. He was appointed archbishop of Smyrna in 1784 and patriarch of Constantinople in 1795. When the French invaded Egypt in 1798, the national spirit of Greece was aroused by hopes of deliverance from the Turkish yoke. Suspicions of conspiracy fell upon Gregory, and the Turks clamored for his head. Sultan Selim therefore banished him to Athos, but he was soon afterwards reinstated in his see. In 1821 the Greeks of the Morea revolted, and 21 March banishment was proclaimed against all who took part in the rebellion. Gregory had been put in charge of the family of Prince Murusi, who without the patriarch's connivance had been permitted to escape by the Russian ambassador. On Easter morning, 22 April, 1821, by command of the sultan Gregory with three bishops and eight of the clergy were hanged in front of the basilica. Three days later the Jews threw his body into the sea, where it was recovered by Greek sailors and carried to Odessa. The Greeks looked upon their murdered archbishop as a martyr, his bones were placed by the government in the cathedral at Athens, and his statue was raised in front of the university. Among his writings is a translation of St. Paul's epistles into modern Greek, with a commentary.

Gregory VI.: b. Rome; d. Cologne 1048. He succeeded John XIX. Finding the lands and revenues of his church much lessened by usurpations, and the roads infested by robbers, he acted with such vigor that a powerful party was raised against him by those accustomed to live by plunder. At a council, held at Sutri, in 1046, Gregory abdicated the pontificate.

Gregory VII. (HILDEBRAND): b. Soana, Tuscany, about 1015; d. Salerno, 25 May 1085. He became a monk at Cluny, and when Bruno, bishop of Toul, was elected pope by the emperor and diet in 1048 Hildebrand accompanied him to Rome, having persuaded him, it is said, to lay aside the insignia of the pontificate until he should receive the free suffrages of the clergy and people of Rome. Henceforth Hildebrand became the ruling spirit of the papacy. Leo IX. (Bruno) and his successors, Victor II. (1055), Nicholas II. (1058), Alexander II. (1061), confided in his counsels. He influenced the election of several of these popes, and procured the expulsion of the anti-popes Benedict and Honorius, who were opposed to Nicholas and Alexander. Under Nicholas II he succeeded in changing the mode of election to the pontificate. Hitherto the clergy and the people of Rome had a voice in the election. He gave the power of nomination to the cardinals alone, leaving the clergy and people only a right of concurrence, of which they were subsequently deprived. On the death of Alexander II. (1073) Cardinal Hildebrand was raised to the Papal chair. His efforts were directed to free the Church from the interference of temporal rulers, which had become quite an abuse in his day, and reform the numerous irregularities which had crept in among the clergy, especially in relation to the violation of the law of celibacy. In 1074 he issued his edicts against simony and the marriage of priests, and in 1075 an edict forbidding the clergy, under penalty of forfeiting their offices, from receiving the investiture of any ecclesiastical dignity from the hands of a layman, and at the same time forbidding the laity, under penalty of excommunication, to attempt the exercise of the investiture of the clergy. The Emperor Henry IV. refused to obey this decree, and Gregory, in 1076, issued a new decree summoning the emperor before a council at Rome, to defend himself. Henry then caused a sentence of deposition to be passed against the pope by a German council assembled at Worms. The pope, in return, excommunicated the emperor, and released all his subjects and vassals from their oath of allegiance. To escape being deposed by the pope, Henry hastened to Italy, where he submitted at Canossa (1077) to a humiliating penance, and received absolution. In the meantime his friends again assembled round him, and he then caused the pope to be deposed by the Council of Brixen, and an anti-pope, Clement III., to be elected in 1080, after which he hastened to Rome and placed the new pope on the throne. Gregory now passed three years as a prisoner in the castle of St. Angelo, but could never be induced to compromise the rights of the church. The character of Gregory was ardent and unyielding. In the pursuit of his ends in guarding the liberties of the Church he spared neither friend nor foe. The long dispute he began with Henry IV. about investitures survived both pope and emperor. The same subject involved him in disputes with France and England. He carried out his ecclesiastical reforms with an unbending rigor. He vigorously prosecuted those of the clergy who broke the law of celibacy, and in his contests with the emperors vindicated the spiritual authority of the Church as independent of the secular power. To the last he refused to withdraw the excommunications he had launched against the emperor, the anti-pope, and their adherents. The words which have been put into his mouth in dying, whether authentic or not, do no injustice to his inflexible spirit, "I have loved justice and hated iniquity; therefore I am left to die in exile." See Milman' 'Latin Christianity' (Vol. III.); Giesebrecht, 'Geschichte der deutsch–Kaiserzeit' (Vol. III.); Bowden, 'Life of Gregory VII.' (1840); Voigt, 'Hildebrand als Papst' (2d ed. 1846); Gfrörer, 'Papst Gregor VII.' (1859–61); Stephens, 'Hildebrand and his Times' (1888); and the studies by Söltl (1847), Villemain (1872; Eng. trans. 1873), Langerton (1874), and Meltzer (1876).

Gregory VIII.: b. Benevento; d. Pisa 17 Dec. 1187. He succeeded Urban III. in October 1187, and died the same year, after having exhorted the Christian princes to undertake a new crusade, and absolved Henry II. of England for the murder of Becket.

Gregory IX. (Ugolino, Count of Segni), b. Campania about 1147; d. Rome 21 Aug. 1241. He became a bishop of Ostia and cardinal, and in 1227 succeeded Honorius III. The principal events of his pontificate were the various incidents of his contest with the great Emperor Frederick II., whom he four times excommunicated, absolving his subjects from their allegiance, and proclaiming a crusade against him. The 'Decretals,' which he published in 1234, form the basis of the canon law of the Church.

Gregory X. (Tebaldo Visconti), d. Arezzo, 10 Jan. 1276. He was elected Pope in 1271, after an interregnum of two years. He convened a council at Lyons in 1274, the chief purpose of which was to promote a union between the Eastern and Western Churches.

Gregory XI. (Peter Roger), b. Maumont, Limoges, France, 1329; d. Avignon, 30 Dec. 1378. He was a nephew of Clement VI., and succeeded to the pontificate in 1370, after the death of Urban V. He was a patron of learning, and endeavored to reconcile the princes of Christendom and to reform the religious societies. He transferred the papal see from Avignon to Rome.

Gregory XII. (Angelo Conario), b. Venice about 1325; d. 18 Oct. 1417. He became pope in 1406, during the great schism of the West, Benedict XIII. being the other pope. Both were deposed by a council held at Pisa, and Alexander V. elected in their stead. Gregory abdicated at the Council of Constance in 1415, and thenceforward held the rank of cardinal-bishop of Porto.

Gregory XIII. (Ugo Buoncompagno), b. Bologna 7 Jan. 1502; d. 10 April 1585. He was one of the theologians of the Council of Trent; on his return thence was created cardinal in 1565. On the death of Pius V. Gregory was elected pope in 1572. Not one among the post-Reformation pontiffs has surpassed Gregory XIII. in zeal for the promotion and improvement of education; a large proportion of the colleges in Rome were wholly or in part endowed by him. The most interesting event of his pontificate, in a scientific point of view, is the correction of the calendar (q.v.), which was the result of long consideration, and was finally made public in 1582. Under his care was published also a valuable edition of the 'Decretum Gratiani' with learned notes. He was a zealous patron of the Jesuits, and supported the League in France against the Huguenots. He strongly supported Philip II. of Spain in his designs against England; and left the mark of his energy on almost every department of church life and work.

Gregory XIV. (Nicholas Sfondrate), b. Cremona 1535; d. 15 Oct. 1591. He was made a cardinal in 1583 and succeeded Urban VII. in 1590.

Gregory XV. (Alessandro Ludovico), b. Bologna 9 Jan. 1554; d. 8 July 1623. He became a cardinal in 1616 and succeeded Paul V. in 1621. He was the founder of the College of the Propaganda, and in 1622 canonized Ignatius Loyola, Francis Xavier and Philip de Neri.

Gregory XVI. (Bartholommeo Capellari) b. Belluno 18 Sept. 1765; d. Rome 1 June 1846. He was made prefect of the Propaganda in 1826 and was in effect minister of foreign affairs. He succeeded Pius VIII. in 1831. His rule was a period of no ordinary interest and difficulty in the history of the Church, and in the relations of the Vatican with the temporal powers of Christendom. Of simple habits he was very active in his conduct of affairs. His 'Triumphs of the Papacy' (1790) has been translated into both German and French.

Gregory, Casper René, American scholar: b. Philadelphia, Pa., 1846. Was graduated at the Universities of Pennsylvania, Princeton and Leipsic (1864–76). He has done important work in New Testament criticism, and has been professor of New Testament exegesis in the theological faculty at Leipsic. In addition to translations of critical works from the German, he has written 'Les Cahiers des Manuscrits Grecs' (1885); and the 'Prolegomena to Tischendorf's Editio Octava Critica Major of the New Testament' (1893).

Gregory, Edward John, English painter: b. Southampton, 1850. He first exhibited at the Royal Academy in 1876, and became known as a genre painter of distinction, whose lightness and refinement, combined with rare technique, were almost more French than English. His most characteristic pictures are 'A Rehearsal' (1882); 'The Swans of the Thames'; and 'Is it a Mouse?'

Gregory, Eliot, American painter and author: b. New York 13 Oct. 1854. He studied at Yale, obtained his education in art at Rome, and at Paris as a pupil of Cabanel and Carolus-Duran, and exhibited both sculpture and painting at the Salon. His pictures include genre works and portraits, among the latter being those of Admiral Baldwin, Ada Rehan and August Belmont. His books, published under the pseudonym "An Idler," are: 'Idler Papers'; 'Worldly Ways and By-Ways' (1898); and 'The Ways of Men' (1900), containing satirical observations on American life, especially that of plutocratic society.

Gregory, Francis Hoyt, American admiral: b. Norwalk, Conn., 1789; d. 1866. He was appointed midshipman in the United States navy in 1809, and during the war of 1812 was attached to the command of Commodore Chauncey on Lake Ontario. He was captured by the English in 1814 and confined till the close of hostilities. He saw service in repressing the Algerine pirates (1815–16) and the buccaneers of the West Indies (1821–23); took part in the Mexican War and commanded the African squadron (1849–52). He retired with the rank of rear-admiral in 1862.

Gregory, John Milton, American educator: b. Sand Lake, N. Y., 16 July 1822; d. Washington, D. C., 20 Oct. 1898. After graduation at Union College in 1846, he entered the Baptist ministry, but soon relinquished preaching for teaching. He was State superintendent of public instruction in Michigan in 1858–63; president of Kalamazoo College 1863–67; and president of the Industrial University in Champaign, Ill., in 1867–80. He published 'Compend of the School Laws of Michigan'; 'Handbook of History' (1866); 'A New Political Economy' (1882); 'Seven Laws of Teaching' (1883); etc.

Gregory of Tours (Gregorius Florentius), historian of Gaul, b. Averni, now Clermont,

France, 538; d. Tours 17 Nov. 593. He lived some time at the court of Austrasia, and became bishop of Tours in 573. His 'Historia Francorum,' though destitute of style or method, contains an invaluable collection of facts bearing on the manners of the Franks and Gallo-Romans, and the historical events of the period, and has caused him to be ranked as the Herodotus of Gaul. He also wrote lives of fathers, ecclesiastics and martyrs, etc. His complete works are contained in Migne's 'Patrologia' (Vol. LXXI.), and his history is included in the first volume of the 'Monumenta Germaniæ Historica' (1884–85).

Grenada (grĕn-ā'da̦) and **Grenadines,** grĕn-a̦-dēnz', islands of the West Indies. Grenada is the most southern of the Caribbean chain, and may be characterized as the most British and the most beautiful of all the British Antilles. Its length is 18 miles, its width 7, and its area 33 square miles. Lofty volcanic craters rise high above fertile and well-watered valleys. The volcanic character of the island is perhaps more marked, and is certainly regarded by geologists as being more recent than that of the northern Caribbees. A lake two miles in circumference lies among the mountains just mentioned, at an altitude of 3,200 feet. St. George, the capital, has a good harbor, a fort, and pretty houses and churches. The island is headquarters of the government of the Windward group (which includes with this the Grenadines, St. Vincent and St. Lucia), and has excellent schools, roads, waterworks, etc. The chief product is cocoa. Population about 54,000, of which number four-fifths are negro peasants. The Grenadines are long, low islands "of quaint forms and euphonious names," lying between Grenada and St. Vincent. The largest of them is less than 8,000 acres in extent, and their total area is approximately 87 square miles. They have in all more than 6,000 inhabitants, who raise and export cattle and provisions.

Marrion Wilcox,
Authority on Spanish America.

Grenade, gre̦-nād', a small hollow ball, cylinder, or cube, of metal, glass, or paper, about two and one half inches in diameter, which is filled with some explosive, and burst by means of a fuse when it falls among the enemy. Until about the end of the 17th century trained soldiers called grenadiers threw grenades by the hand. Grenades have been delivered from mortars, to repel the close attacks of besiegers sheltering themselves under the besieged walls. They have been found useful also in repelling boat attacks. At the siege of Mafeking in 1899–1900 dynamite grenades are said to have been thrown by the besieged. Grenades were one of the earliest forms of explosive projectiles. The gradual disuse of hand-grenades in war dates from the battle of Steinkerque in 1690. Hand-grenades are in use at the present time as fire extinguishers, chemicals being used to fill hollow glass balls, which are thrown into a burning mass. Many hotels, hospitals and public buildings in the United States are equipped with hand-grenades.

Gren'fell, George, English missionary and African explorer: b. Penzance, Cornwall, England, 1848. In 1874 he was despatched to Kamerun, Central Africa, where he founded the settlement of Victoria. He later reached the Congo, and rendered good services to science by his hydrographic survey of the Congo valley during his voyage in the steamboat "Peace." Notable was his exploration of the Ubangi (1885) whose identity with the Welle Makua he convincingly established. The geographical societies of Germany, France and England, published valuable communications from this intrepid traveler, who shares with Livingstone the reputation of a missionary who did much to promote an accurate scientific knowledge of interior Africa.

Gren'ville, George, English statesman: b. 1712; d. 13 Nov. 1770. He became treasurer of the navy in 1754, secretary of state in 1762, and first lord of the treasury and chancellor of the exchequer in April, 1763. In 1765 the Commons accepted his scheme for stamp-duties to be levied in the American colonies, which was one of the proximate causes of the American War of Independence. In 1766 he defended the stamp act in Parliament; in 1769 opposed the expulsion of Wilkes from the House of Commons, and in 1770 brought in the Controverted Elections Bill, which was passed. He was able, hard-working and honest, but narrow-minded and obstinate, wanting in tact and foresight. The 'Grenville Papers,' edited by W. J. Smith (1852–53), contain interesting information on the politics of the day.

Grenville, Sir **Richard,** English naval officer: b. about 1541; d. September 1591. In 1585 he commanded a fleet of seven vessels intended to aid in the colonization of Virginia. His most brilliant exploit occurred in 1591, when he attempted to cut his way through a Spanish fleet of 53 ships. His ship while becalmed was attacked by 15 of the largest Spanish vessels. Not till after 15 hours of battle and when only 20 out of his 150 men were left alive did he strike his colors. He died from wounds received in the engagement. It is upon this incident that Tennyson has founded his spirited ballad, 'The Revenge.'

Grenville Act, 6 April 1764. An act passed by the English Parliament on the proposal of George Grenville, a member of Lord Bute's ministry. Its purpose was more effectively to protect English trade and manufactures from foreign competition, to raise better revenues from the colonies. It was based on the act of 1733, which, to protect the British West India sugar industry, laid prohibitory duties on the import of French West India sugar and molasses into the colonies, and which, if enforced, would have ruined New England commerce. The new act made the duty on molasses a heavy revenue one instead; increased the duty on sugar, and laid new duties on wines; decreased the drawbacks on foreign articles exported to America; imposed regulations on manufacturers, and attempted to enforce the navigation acts more thoroughly; and prohibited all trade between the colonies and the French islands St. Pierre and Miquelon.

Gresh'am, Walter Quinton, American jurist and statesman: b. near Lanesville, Harrison County, Ind., 17 March 1832. His family originated in Kentucky, from which State his grandfather had removed to Indiana. There his father met with success as a farmer, and

also exercised the art of cabinet-making. He was elected sheriff and was murdered in the performance of his duties. The son was educated at the local school, and the State University, Bloomingdale, Ind. After leaving the latter he went to Corydon, Ind., and began the study of law, while filling the office of deputy clerk (1854). In 1860 he was elected to the State legislature. When the Civil War broke out he was commissioned in the Federal service as lieutenant-colonel of the 38th Indiana regiment. He was promoted under Grant, and at Vicksburg had charge of a brigade with the rank of brigadier-general of volunteers. He joined Sherman's forces in the expedition against Atlanta, Ga., where he commanded the 4th division of the 17th Army Corps. At Leggetts Hill, in January, 1864, he was severely wounded and disabled from service, and in the following year was retired as major-general of volunteers. He chose as his home New Albany, Ind., and began an active life as law practitioner. In 1866 he was put forward by his friends as Republican candidate for Congress, but was defeated at the polls, and for the two following years resided in New York, as the financial agent of his State. His next field of activity was as a jurist, for in 1869 President Grant appointed him judge of the United States circuit court for Indiana. He had previously declined an appointment as collector of customs at New Orleans, which would have necessitated his removal from Indiana. He had also declined the position offered him as district attorney. But his great abilities and high character had pointed him out as fitted for some important employment, and in 1882 no surprise was felt, but rather general expectation was satisfied when he received an appointment to the cabinet with the portfolio of postmaster general (1882). In 1884 he was called to the secretaryship of the treasury, in the discharge of whose duties he would doubtless have increased his reputation as a financier, had he not been appointed a few months later as United States circuit judge for the 7th judicial district. He made himself conspicuous as favoring the third term of his old friend Gen. Grant (1880). His own name had been put forward with some enthusiasm as presidential candidate in 1884, and again in 1888. There were many who thought that he had good claims to be invested with the office of the chief magistrate. Subsequently he changed his convictions on the most important question of the hour, and ranged himself on the side of views of tariff legislation with which the Republican party had no sympathy. The Populists, however, looked upon him with favor as his judicial decisions had in many cases been to their advantage. Had he consented, they would have nominated him for the presidency at the national convention of that party held at Omaha, Neb., in July 1892. He declined the honor and made a public statement announcing his purpose of supporting Grover Cleveland's nomination. He was afterward named by President Cleveland as secretary of state.

Gresham's Law, a principle in finance and political economy formulated about the middle of the 16th century by Sir Thomas Gresham, founder of the London Royal Exchange. It may be thus stated and expounded. Bad money drives out good money from the circulation. The good coin of full weight and purity in circulation with worn, light, or depreciated coins, will be hoarded or used for exportation, where it will buy more abroad than the worn out coins, which will be left to pass as counters at home. This law is still a living principle, and especially applicable in controverting the position of those who wish the United States, single-handed, to issue a currency of the double standard.

Gres'well, William Henry, English Anglican clergyman and author. He was educated at Oxford and has been rector of Dodington, Somerset, from 1888. As a writer he is known by 'Our South African Empire' (1885); 'Imperial Federation' (1887); 'History of the Canadian Dominion' (1890); 'Geography of the Canadian Dominion' (1891); 'Geography of Africa South of the Zambesi' (1892); 'The British Colonies and Their Industries' (1893); 'Growth and Administration of the British Colonies' (1897).

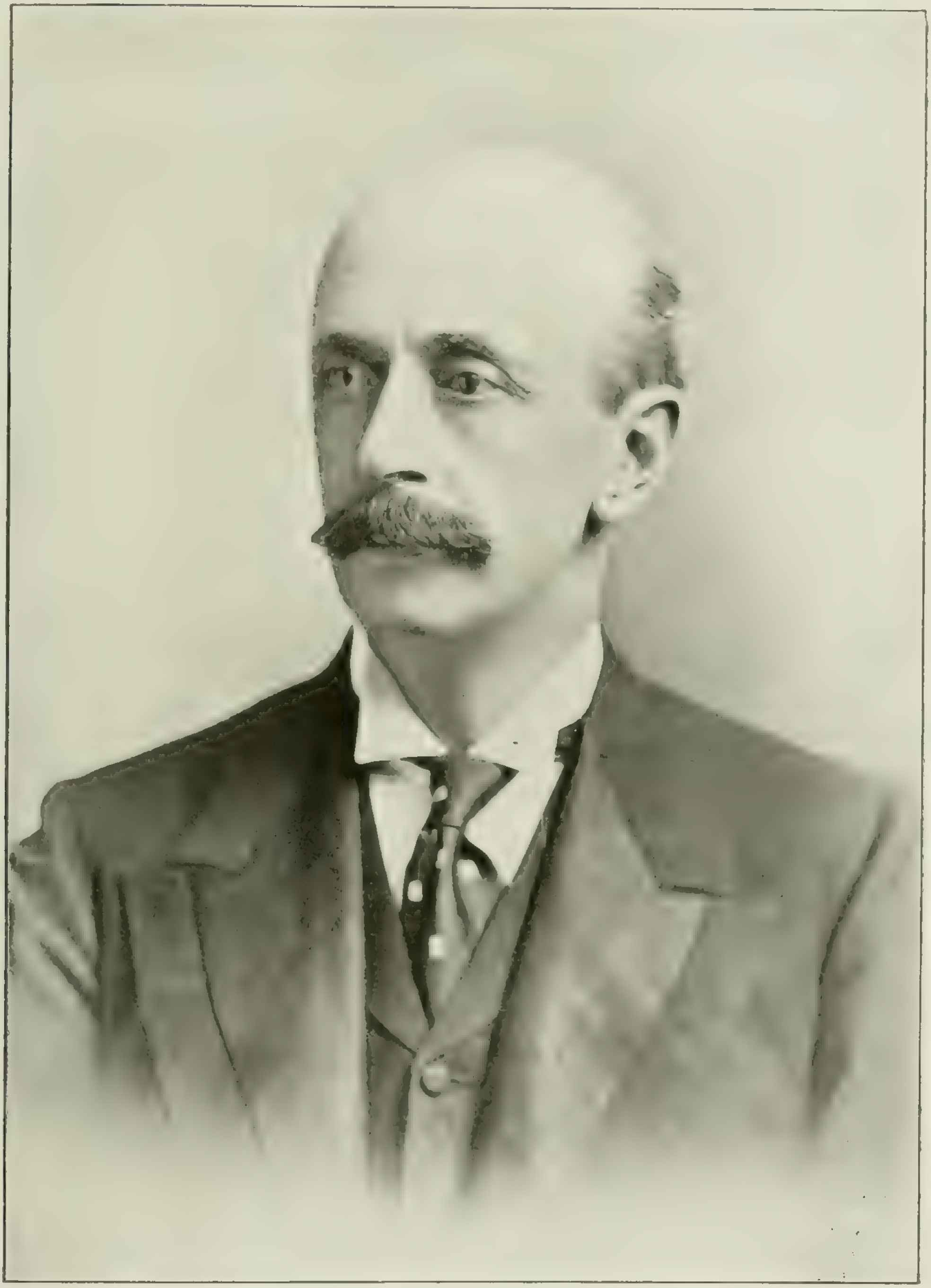
Gretna, La., town, capital of Jefferson Parish; on the Mississippi River and the Southern Pacific railroad; opposite New Orleans. A number of the Mississippi River packet lines take on and discharge shipments at Gretna. It was founded in 1835, and has now many of the advantages of a suburb of New Orleans. It manufactures cottonseed oil and its trade is chiefly in cotton and cottonseed oil. Pop. 3,875.

Gretna Green, or **Graitney**, Scotland, village in Dumfriesshire, on the Solway Frith, eight miles north of Carlisle. It was for nearly a century notorious as the place of celebration of the marriages of runaway couples from England. To conclude a lawful marriage in Scotland, it was then only necessary for an unmarried couple to go before witnesses and declare themselves man and wife. The English marriage service was usually read at these marriages by a pseudo-priest, said to be the blacksmith of the village, who has become in consequence a historical character in fiction. Gretna Green marriages are now at an end, in consequence of a statute which enacts that no irregular marriage contracted in Scotland shall be valid, unless one of the parties resides in Scotland, or has done so, for 21 days next preceding such marriage.

Grétry, André Ernest Modeste, äṅ-drā ėr-nā mō-dĕst grā-trē, French composer: b. Liège 8 Feb. 1741; d. Ermenonville 24 Sept. 1813. After completing his studies at Rome he settled at Paris and there his reputation was made. He was the most prolific composer of his age. He produced forty comic operas, most of which with the exception perhaps of 'Raoul' and 'Richard Cœur de Lion' are now forgotten. His 'Memoires' 1796, and his life by Gregoir and Brenet give the main incidents of his career.

Grev'ille, Henry. See DURAND, ALICE MARY.

Grevy, François Paul Jules, fräṅ-swä pōl zhül grā-vē, French statesman: b. Mont-sous-Vaudrey, Jura, 15 Aug. 1807; d. 9 Sept. 1891. He studied law in Paris, and became prominent as the defender of republican political prisoners. In 1848 he was returned to the Constituent Assembly, where his ability as a speaker soon



ALBERT HENRY GEORGE, THE FOURTH EARL GREY,

GOVERNOR-GENERAL OF CANADA.

made him distinguished. After the *coup d'état* he retired from politics, but in 1869 again entered the Assembly as deputy for the Jura. In February, 1871, he was elected president of the National Assembly, and re-elected in 1876, 1877, and 1879. When Marshal MacMahon resigned in 1879 Grevy was elected president of the republic for seven years. In December, 1885, he was elected president for a second term of seven years, but, hampered by ministerial complications, resigned in December 1887.

Grey, Albert Henry George, Fourth Earl, English statesman: b. Howick, Northumberland, England, Nov. 28, 1851. His grandfather, the second earl, was prime minister of England, and influential in securing the passage of the Reform Bill of 1832. The present earl was graduated from Trinity College, Cambridge; in 1880 he was elected to Parliament, as a Liberal, and supported Gladstone in the House until 1886 when the Liberals declared in favor of home rule. He then became a Liberal Unionist, but lost his seat in Parliament. In 1894, as his uncle died childless, he succeeded to the estate and title, and entered the House of Lords. He was a personal friend of Cecil Rhodes, was one of the promoters of the South African Company, and in 1896–97 served as governor of Rhodesia. As an executor of the Rhodes will, he is now one of the trustees of the scholarship fund. He has been an active worker in reform movements, especially in the cause of co-operation and of temperance. On his estate he has organized a co-operative system which has worked successfully; and in 1901 he organized a system for the management of public houses in the interests of the public, known as the Public House Trust. In 1904 he was appointed governor-general of Canada to succeed the Earl of Minto.

Grey, Lady Jane, English princess: b. Bradgate, Leicestershire, 1537; d. Tower Hill, London, 12 Feb. 1554. She was the daughter of Henry Grey, marquis of Dorset, afterwards duke of Suffolk. She displayed much precocity of talent; possessing an acquaintance with the classic and oriental languages, as well as French and Italian. She was married to Lord Guildford Dudley, fourth son of the Duke of Northumberland, in May 1553. Edward VI. was induced at his death 5 July 1553 to settle on her the succession to the crown. The council endeavored to keep his death secret, with a view to secure the persons of the princesses, Mary and Elizabeth. Mary apprised of their design, wrote expressing her surprise that she had not been advised of her brother's death, and commanding them on their allegiance to proclaim her title. The council replied, exhorting her to be quiet and obedient, and proclaimed Lady Jane on the 10th. On the approach of Mary the council, unsupported in their usurpation, meanly deserted their victim Lady Jane, and joined in proclaiming Mary queen on the 19th, and on the 20th Lady Jane was confined to the Tower. On 13 Nov. she and her husband were arraigned, and pleaded guilty of high treason; but they might, perhaps, have been allowed to expiate their imprudence by a temporary confinement, but for the ill-advised insurrection under Sir Thomas Wyatt, in which the Duke of Suffolk, Lady Jane's father, was weak enough to participate. The suppression of this rebellion was followed by the execution of Lady Jane Grey and her husband on Tower Hill.

Greyhound. A long, tall, slender hound, the standard features of which are described under DOG. It hunts by sight, is fitted for the swiftest running and leaping, and is used in the sport of coursing (q.v.). In the United States greyhounds are kept mainly as pets; yet in the West are used in chase of jack-rabbits, prong-horn antelopes and coyotes. Few horses are able to keep up with them, even in a level country, and on an irregular surface they distance horses easily. The modern thin, smooth-haired type, to which the name is now popularly restricted, is a development from a form which arose in western Asia before the Christian era, and was adopted and esteemed in Syria, Egypt and Rome, during the classic period. It was taken west with the Romans in their conquest of Europe, and later became the favorite dog of the nobility, an accompaniment of falconry. At that time black, or black-and-white were the approved colors. There seems to have been little essential change of form or qualities during this prolonged history, and literature and art abound in commemoration of the dog's grace, kindliness and exploits in the field. There arose at an early time a diminutive variety not half the size of its namesake (about 7 pounds in weight) fragile, delicate, and of no use save as an ornamental pet, which is now known as the Italian greyhound. It is of almost any whole color,— black, mouse-grey, fawn or rarely white. Besides these satin-coated «long-dogs,» others arose in the colder parts of Europe which differed from the greyhound only in having a «rough,» that is long-haired, coat. These are the Irish wolfhounds (see WOLFHOUND), the Scotch stag or deerhound (see DEERHOUND), and the Russian wolfhound or psovie (see BORZOI).

Greytown, old name SAN JUAN DE NICARAGUA, destroyed in 1854 by the United States. (For the general situation, see CLAYTON-BULWER TREATY.) In May 1854 the captain of an American steamship had a quarrel with a negro, and shot him dead; the mayor of the city ordered him arrested, and the passengers on the ship, as well as Solon Borland, the United States minister to Nicaragua, took the captain's part and resisted the arrest. The native inhabitants were indignant and mobbed Borland, whereupon the United States war-vessel Cyane, Commander Hollins, was sent to exact reparation. Hollins espoused the cause of an American transit company who were making excessive claims, and ordered the mayor to pay them at once; on their refusal he bombarded and burnt the place. This outrage embroiled the United States with Great Britain.

Gridley, Charles Vernon, American naval officer: b. Logansport, Ind., 24 Nov. 1845; d. Kobe, Japan, 5 June 1898. A graduate (1863) of the United States Naval Academy, he served during the Civil War in the West Gulf blockading squadron, subsequent to the war was on various ships, and in 1875–79 was stationed at the Naval Academy. He was navigation officer in the Boston Navy Yard in 1882–84, was lighthouse inspector in 1887–91 and 1895–97, in 1897 attained the rank of captain and was ap-

pointed to the command of the Olympia, then flagship of the Asiatic squadron. This vessel he commanded in the battle of Manila Bay 1 May (1898). He died at Kobe.

Gridley, Richard, American soldier: b. Boston, Mass., 3 Jan. 1711; d. Stoughton, Mass., 20 June 1796. He served in the British army as lieutenant-colonel of engineers under Pepperell at the capture of Louisburg in 1745; as chief engineer and colonel of infantry in 1755; took part in the expedition to Crown Point under Winslow in 1756; under Amherst in 1758; and under Wolfe at Quebec in 1759. He was appointed chief engineer and commander of the artillery of the American army upon the outbreak of the Revolution, constructed the fortifications on Breed's Hill before the battle of Bunker Hill, and later fortified Dorchester Heights. He was commissioned major-general by Congress on 20 Sept. 1775, and commanded the Continental Artillery till November of that year.

Grieg, Edvard, ĕd'värd grēg, Norwegian composer: b. Bergen 15 June 1843. His great-grandfather, Alexander Greig, was a Scotchman who emigrated to Norway after the battle of Culloden (1745) and changed his name to Grieg. Edvard's father was British consul at Bergen; he married the Norwegian Gesine Judith Hagerup, a descendant of Kjeld Stub; from her, Edvard inherited his musical gifts; she was a good musician and gave him lessons. By the advice of Ole Bull, Edvard was sent to the Leipsic Conservatory at the age of 15; he remained there three years, studying with Plaidy, Wenzel, Moscheles, E. F. Richter, Hauptmann, Reinecke. Their lessons, and the music he for the most part heard and studied, impressed a German stamp on his mind, which characterizes his first compositions. His studies were interrupted by an illness, a severe case of pleurisy, which destroyed one of his lungs and left his health impaired for life. On his return to the North he came under the influence of three Scandinavian musicians: the composer Gade, who gave him many useful hints; Ole Bull, an ardent musical patriot, who made him familiar with the charming folk-tunes of Norway, which he played so entrancingly; and Richard Nordraak, who encouraged him in his natural inclination to get out of the maelstrom of German music and steer into the fjords of Norway. From 1866 to 1873 he lived at Christiania, conducting the Philharmonic concerts and giving lessons. He also gave subscription concerts, with the aid of his cousin, Nina Hagerup, whom he married on 11 June 1867; she was an excellent vocalist, whose art was a great aid in winning favor for his songs. In 1868 Liszt accidentally came across Grieg's first violin sonata (Op. 8), and was so much impressed by the evidence of creative power it gave that he invited him to come and spend some time in his studio. It was in consequence of this flattering letter that the Norwegian Government gave Grieg a sum of money which enabled him to visit Rome. There he repeatedly met Liszt, who became more and more impressed by the boldness and the national traits of his genius; he urged him to persevere in his original course and not to let the critics intimidate him.

In 1874 Henrik Ibsen asked Grieg to write the music for a stage version of his 'Peer Gynt.' The offer was accepted and the play was produced, with much success, in 1876. It is often given in Scandinavian cities; elsewhere it has not succeeded, because of its untheatrical, fantastic character and its grotesque local coloring; but the music, arranged for the concert hall in the form of two suites, soon made Grieg one of the most popular composers in all countries. In the same year that Ibsen invited him to compose the music for 'Peer Gynt,' the Norwegian Government honored him with an annuity of 1600 crowns for life. This relieved him of the drudgery of teaching and enabled him to devote most of his time to composing. For several years he lived at Lofthus, on the Hardanger Fjord. At Bergen, 1880–1882, he conducted a musical society called the 'Harmonien.' In 1885 he built the elegant villa Troldhaugen, overlooking the fjord, about 8 kilometres from Bergen; there he has lived ever since. After his fame was well established, about 1880, he left his home frequently for concert tours in Germany, France, and England. Everywhere he was acclaimed as one of the most individual and enchanting of pianists (he played only his own pieces), and usually all the seats for his concerts were sold long before their dates. Sometimes he conducted his orchestral compositions. "How he managed to inspire the band as he did and get such nervous thrilling bursts and such charming sentiment out of them I don't know," wrote Sir George Grove, in 1888. In 1893 a writer in the Paris Figaro said: "Among the most famous living musicians there is none I know of whose popularity equals, with us, that of M. Grieg." In 1899, Colonne invited him to Paris to conduct a Grieg concert; but it was just after the verdict in the Dreyfus case, which had made Grieg so indignant that he refused the invitation. When it was repeated, four years later, he accepted. There was a tremendous crowd; cries of "apologize, you have insulted France!" were heard; but the vast majority was with him, and the concert proved one of his biggest triumphs.

Grieg has done for Norway what Chopin did for Poland, Liszt for Hungary, Dvorák for Bohemia; he has created a new national art. This great achievement, unfortunately, stood in the way of the full recognition of his superlative genius. It is still commonly assumed that he did little more than transplant to his garden the wild flowers of Norwegian folk-music, whereas, in truth, ninety-five hundredths of his music is absolutely his own. He ranks with Schubert and Chopin both as a melodist and a harmonist. His persistent ill-health prevented him from writing operas and symphonies; most of his works are songs and short pianoforte pieces. The songs, 125 in number, are of striking originality and depth of feeling. The equally numerous short pieces for piano (including 66 "lyric pieces" in one vol.) are as idiomatic as Chopin's. There are also 5 sonatas: one for piano alone, three with violin, one with 'cello, beside a string quartet. The orchestral list includes: Overture, 'In the Autumn'; 'Holberg' suite; 2 'Peer Gynt' suites; 'Sigurd Jorsalfar'; arrangements of Grieg songs and Norwegian dances. Choral works: 'At the Cloister Gate'; 'Landsighting'; 'Olaf Trygvason.' 'Berg-

liot' is a poem for declamation, with orchestra. The only books on Grieg and his works are by Schjelderup, in Norwegian, and by the author of this article, in English. The latter contains a list of pamphlets and magazine articles on Grieg.

Henry T. Fink,
Musical Director, New York Evening Post.

Griesbach, Johann Jakob, a noted German New Testament scholar, biblical critic and theologian: b. Butzbach in Hesse-Darmstadt, 4 Jan. 1845; d. Jena, 24 March 1812. He was educated at Frankfort-on-the-Main; later studied theology at Tübingen, Halle, and Leipzig; during 1769–70 traveled extensively in England, France and Holland; in 1771 became docent and in 1773 professor extraordinary in theology at Halle; and from 1775 till his death was professor ordinary at Jena. Griesbach's most important work — to which he devoted the best years of his life — was the collecting and classifying of the ancient manuscripts and versions of the Greek text of the New Testament. His critical researches, the result of which appeared in his edition of the Greek New Testament (Halle, 1775–7) one of the first ever printed, are valuable and in the main correct. It was he who first divided the authorities for the text of the Greek New Testament into the three great families — Alexandrine, Latin or Western, and Byzantine or Eastern.

Griffin, Charles, American soldier: b. Licking County, Ohio, 1826; d, Galveston, Texas, 5 Sept. 1867. He was graduated at West Point (1847) and served through the Mexican War. In the Civil War he commanded the 5th artillery at the first battle of Bull Run, and on 6 May 1864 was brevetted lieutenant-colonel in recognition of gallant and meritorious services in the field. He was one of the commissioners to carry out the condition agreed upon by Gens. Grant and Lee.

Griffin, Gerald, Irish novelist; b. Limerick, Ireland, 12 Dec. 1803; d. Cork, 12 June 1840. He will be longest remembered for his novel 'The Collegians' (1829), upon which Boucicault's popular play, "The Colleen Bawn," is founded. Griffin was a poet as well as a writer of tales and the author of various lyrics popular with his countrymen.

Griffin, Sir **Lepel Henry,** English diplomatist: b. 1840. He entered the Bengal Civil Service in 1860 and since then has been administrator of the civil government in several places, especially in the Punjab. In 1885 he was nominated by Lord Salisbury's government as Envoy Extraordinary to Pekin. He has written 'The Punjab Chiefs' (1865); 'The Rajahs of the Punjab' (1870); 'The Great Republic' (1884).

Griffin, Ga., city, county-seat of Spalding County, on the Southern and the Central of G. R.R.'s. It is the centre of a cotton and fruit region, the chief fruits being grapes and peaches. The city contains cotton-mills, a foundry, and furniture factories; wine is also manufactured. The State Agricultural Experiment Station is located in the vicinity. Pop. (1900) 6,857.

Griffin, or **Gryphon,** in mythology, a fabulous animal, usually represented with the body and legs of a lion, and the head and wings of an eagle, signifying the union of strength and agility. Figures of griffins are frequently used as ornaments in works of art. It is employed as an emblem of vigilance, the animals being supposed to be the guardians of mines and hidden treasurers. Figures of it are met with in tombs and sepulchral lamps, as guarding the remains of the deceased.

Griffis, William Elliott, American clergyman and author: b. Philadelphia 17 Sept. 1843. He was graduated from Rutgers College in 1869, and 1870 went to Japan to organize schools after American methods in the province of Echizan, made a study of the Japanese feudal system, and was professor of physics in the Imperial University in 1872–74. In 1874 he returned to the United States, where he was graduated from the Union Theological Seminary in 1877. He was pastor of the First Reformed Church, Schenectady, N. Y. (1877–86), of the Shawmut Congregational Church, Boston (1886–93), and of the First Congregational Church of Ithaca, N. Y. (1893–1903). In 1891 he was a delegate to the International Congregational Council at London. From 1903 he turned his attention wholly to literary work. An authority on Japan, he also studied the Dutch origins of America and the influence of the Dutch in the formation of the United States. His published works include 'The Mikado's Empire' (1876), his best known volume, which has appeared in many subsequent editions; 'Japanese Fairy World' (1880); 'Corea: the Hermit Nation' (1882); 'Corea, Without and Within' (1884); 'Matthew Gailbraith Perry: a Typical American Naval Officer' (1887–90); 'The Lily Among Thorns' (1889); 'Honda the Samurai' (1890) 'Sir William Johnson and the Six Nations' (1891); 'Japan in History, Folklore and Art' (1892); 'Brave Little Holland' (1894); 'Townsend Harris: First American Envoy in Japan' (1895); 'The Romance of Discovery' (1897); 'The Pilgrims in their Three Homes' (1898); 'The Romance of American Colonization' (1898); 'The Romance of American Conquest' (1898); 'The American in Holland' (1899); 'The Pathfinders of the Revolution' (1900); 'In the Mikado's Service'; 'A Maker of the New Orient'; 'Sunny Memories of Three Pastorates' (1903).

Griffiths, Arthur George Frederick, English soldier and author: b. Poonah, India. He served in the Crimean War, was inspector of prisons 1878–96, edited 'The Fortnightly Review' (1884), and is editor of 'The Army and Navy Gazette.' He is the author of 'The Queen's Shilling' (1872); 'Memorials of Millbank' (1875); 'Lola: a Tale of the Rock' (1878); 'Chronicles of Newgate' (1883); 'A Prison Princess' (1890); 'Secrets of the Prison House' (1893); 'Criminals I Have Known' (1895); 'The Rome Express' (1896); 'Wellington and Waterloo'; 'Mysteries of Police and Crime' (1898); 'A Girl of Grit' (1898); 'Ford's Folley, Ltd.' (1899); 'The Brand of the Broad Arrow' (1900); 'A Set of Flats' (1901); 'A Duchess in Difficulties'; 'Tales by a Government official'; etc.

Griffon, or **Bassett-griffon**, a large grayish-red field-dog, combining the qualities of both pointer and setter, but having a thick hard coat enabling it to work readily in thickets and rough country. It originated in Germany at the end of the 19th century.

Griggs, Edward Howard, American lecturer: b. Owatonna, Minn., 9 Jan. 1868. In 1889 he was graduated from Indiana University (Bloomington), and later studied at the University of Berlin, and was successively instructor in English literature and professor of literature in Indiana University. Subsequently he became professor of ethics, and upon the combining of the departments, professor of ethics and education, in the Leland Stanford, Jr., University. From 1899 he was active as a public lecturer, particularly in connection with the courses of the Brooklyn (N. Y.) Institute of Arts and Sciences. He wrote 'Moral Education' (1905).

Griggs, John William, American politician: b. Newton, N. J., 10 July 1849. He was graduated at Lafayette College in 1868, and was admitted to the bar in 1871, practising in Paterson, N. J. He was a member of the New Jersey General Assembly, 1876–77; a state senator, 1882–88; and president of the state senate in 1886. He became governor of New Jersey 1 Jan. 1896, resigning 31 Jan. 1898 to become attorney-general in President McKinley's cabinet. He resigned in April, 1901.

Grijalva, Juan de, hoo-än' dā grē-häl'vä, Spanish navigator: b. Cuellar 1489 or 1490; d. Nicaragua, 21 Jan. 1527. He was intrusted by his uncle, Don Diego Velasquez, the first governor of Cuba, with the command of a fleet of four vessels, which, on 1 May 1518, sailed from St. Jago de Cuba, to complete the discoveries which Fernandez de Cordova had made in Yucatan the year preceding. Rounding the peninsula of Yucatan, he extended his explorations as far as the province of Panuco, giving his name and that of his companion, Alvarado, afterward famous in the expedition of Cortes, to two rivers on the coast. His communication with the Aztecs was friendly, and so profitable that he was enabled to send back one of the ships well freighted with gold, jewels, and other treasures, the acquisition of which was one of the main objects of the expedition. On his return to Cuba he found an expedition organizing for the conquest of Mexico, with Cortes at the head, and was received by Velasquez with reproaches for having neglected to plant colonies on the coast. Grijalva, a man of integrity and prudence, had, however, acted strictly in conformity with his instructions, and against his own judgment. In the latter part of his life he settled in Nicaragua, and was slain in an outbreak of the Indians in the valley of Ulancho.

Grillparzer, Franz, fränts grĭl'pärt-sĕr, German poet and dramatist: b. Vienna 15 Jan. 1791; d. there 21 Jan. 1872. In 1813 he entered the service of the imperial court, retiring to private life with the title of Hofarth (court councillor), in 1856. In 1861 he was appointed member for life of the imperial council. He became known as a dramatist in 1816 by his 'Ahnfrau,' a tragedy of the fatalistic school, which still keeps the stage. It was followed by the dramas 'Sappho' (1819); 'Das Goldene Vliess' (1822); 'Des Meeres und der Liebe Wellen' (1840), an adaptation of the legend of Hero and Leander. Perhaps the finest of Grillparzer's products is the historical drama of 'König Ottokar's Glück und Ende' (1825).

Grilse, a young salmon (q.v.).

Grimes, James Wilson, American politician and legislator: b. Deering, Hillsboro County, N. H., 20 Oct. 1816; d. Burlington, Ia., 7 Feb. 1872. He was graduated at Dartmouth College (1836), and went west, where he began the practice of the law, was appointed secretary of a commission instituted to negotiate the transfer of lands from the Sac and Fox Indians, and after the organization of Iowa Territory in 1838, he was elected to its legislature. He was elected governor of Iowa in 1854, and after completing his term, was sent to Congress as a Republican Senator. He voted for the acquittal of President Johnson at his impeachment trial.

Grimké, grĭm'kė, **Archibald Henry,** American lawyer: b. Charleston, S. C., 17 Aug. 1849. He was graduated from Lincoln University in 1870, from the Harvard Law School in 1874, and in 1883–85 was editor of the 'Hub,' a Boston newspaper. In 1891–92 he was a special writer for the Boston *Herald* and *Traveller*, and in 1894–98 United States consul at Santo Domingo. His writings include a 'Life of William Lloyd Garrison' (1891), a 'Life of Charles Sumner' (1892), and numerous contributions in periodicals, dealing chiefly with various questions pertaining to the American negro.

Grimké, Thomas Smith, American lawyer and scholar: b. Charleston, S. C., 26 Sept. 1786; d. near Columbus, Ohio, 12 Oct. 1834. He was graduated at Yale College in 1807, studied law at Charleston and rose to eminence at the bar and in the politics of his State. He became widely known by his addresses in behalf of peace, religion, and literature. An early and prominent advocate of the American Peace Society, he held the opinion that even defensive warfare is wicked. Though a superior classical scholar, he maintained that neither the classics nor mathematics should enter into any scheme of general education in this country. In some of his pamphlets he introduced a new system of orthography of the English language. A volume of his addresses was published at New Haven in 1831.

Grimké Sisters, The, Sarah Moore, and Angelina Emily: b. Charleston, S. C., 1792 and 1805; d. Hyde Park, near Boston, 1873 and 1879. They were sisters of Thomas Smith Grimké (q.v.). They liberated their slaves, removed to Philadelphia, entered the Society of Friends, and became known in connection with the Anti-slavery movement. They went to New York in 1836 and in the year following to Boston; were leaders in the American Anti-Slavery Society, and appeared as platform speakers on slavery. In 1854 they established a successful coeducational academy at Eagleswood (near Perth Amboy), N. J. Sarah lectured also on woman's rights. Angelina wrote 'An Appeal to the Christian Women of the South'; Sarah an 'Epistle to the Clergy of the Southern States.'

Grimm, Jakob Ludwig, yä'kōb lood'vĭg grĭm, German philologist: b. Hanau, Hesse-Cassel, 4 Jan. 1785; d. Berlin, 20 Sept. 1863. In 1806 he became librarian to Jerome Bonaparte, king of Westphalia, and from 1816 to 1829 occupied the post of second librarian at Cassel. From 1830 to 1837 he resided at Göttingen as professor and librarian, lecturing on the German language, literature and legal antiquities. Hav-

ing, with six other professors, resisted the unconstitutional encroachments of the King of Hanover, he was banished, and after his retirement to Cassel, he was, in 1841, called to Berlin as a professor and member of the Academy of Sciences. He sat in the National Assembly of 1848, and in that of Gotha in 1849. From that time till his death, he occupied himself only with his various publications. He wrote on German mythology, German legal antiquities, the history of the German language, and published old German poems, etc. His two greatest works, both unfinished, are his 'Deutsche Grammatik' (1819–37), and his 'Deutsches Wörterbuch' commenced in 1852, in conjunction with his brother Wilhelm (q.v.), and gradually completed by eminent scholars. He also published, in company with his brother, the 'Kinder und Hausmärchen,' one of the most popular collections of juvenile fairy tales.

Grimm, Wilhelm Karl, vĭl'hĕlm kärl, German philologist: b. Hanau, 24 Feb. 1786; d. Cassel, 16 Dec. 1859. He was the companion in study of his brother, Jakob Grimm (q.v.), at the Lyceum of Cassel, the University of Marburg, and again at Göttingen, where in 1830 he was appointed under-librarian and supernumerary professor of philosophy. He joined his brother in the protest against the King of Hanover, shared his exile, and also his call to Berlin. There they labored together, and were commonly known as the Brothers Grimm. Under that name also they have a certain immortality in the affections of the civilized world. His earliest independent work was a German translation of the Danish 'Kœmpe-Viser' (1811–13). He edited many old German texts and collaborated with his brother Jakob in several of his works. His own most important book is 'Die deutsche Heldensage' (1867), and 'Kleinere Schriften,' (1881–86).

Grimm's Law is the name given to the rule which regulates the *Lautverschiebung*, or permutation of certain primitive consonants, which takes place in the Teutonic languages. The law, as finally formulated by Jakob Grimm, is that if the same roots or words exist in Sanskrit, Greek, and generally in Latin, Celtic, Lettic, and Slavonic, and also in Gothic, English, Dutch, and other Low German dialects on the one hand, and in Old High German on the other, the following correspondences are to be expected: (1) Gothic has a soft mute. and High German a hard mute, in place of the corresponding aspirate in Sanskrit and Greek; (2) Gothic has a hard mute, and High German an aspirate, in place of the corresponding soft mute in Sanskrit and Greek; (3) Gothic has an aspirate, and High German a soft mute, in place of the corresponding hard mute in Sanskrit and Greek. Thus, a primitive *th* becomes *d* in Low German, and *t* in High German, as in the words *th*ugatēr, *d*aughter, *t*ochter. A primitive *d* becomes *t* in Low German, and *z* in High German, as in *d*uo, *t*wo, *z*wei; or *d*ens, *t*ooth, *z*ahn; or *d*ecem, *t*en, *z*ehn. A primitive *t* becomes *th* in Low German, and *d* in High German, as in *t*res, *th*ree, *d*rei; or *t*u, *th*ou, *d*u; or *t*enuis, *th*in, *d*ünn. Similar changes affect the labials and gutturals, as in *p*ecus, *f*ee, *v*ieh; *p*ater, *f*ather, *v*ater; *f*agus, *b*eech. *p*uocha; and in oculus, eg*h*e («eye»), auge; *q*uis, *w*ho, *w*er; or *kh*ortos, garden, *k*orto. The normal changes are set forth in the following table:

	Labials			Dentals			Gutturals		
Greek, etc.........	p	b	ph	t	d	th	k	g	kh
Gothic, etc.........	f	p	b	th	t	d	(h)	k	g
Old High German..	b(v)	f	p	d	z	t	g(h)	ch	k

The credit of the discovery of the *Lautverschiebung* is not wholly due to Jakob Grimm. Ihre and Rask had discovered, as early as 1818, the law of the transmutation of consonants in Greek and Gothic, while Grimm, in the second edition of his 'Deutsche Grammatik'; which appeared in 1822, added the corresponding changes in Old High German, and formulated the law as it now stands.

Grimm's Law may be interfered with by the action of other laws, especially by the position of the accent, as formulated in Verner's Law (q.v.). Thus *fráter* is accented on the first syllable and *patér* on the second, consequently, though we have *brother* and *father* in English, we find *bruder* and *vater* in High German. The accent in *patér* has interfered with the regular action of the *Lautverschiebung*, and prevented the normal change of *t* to *d* from taking place.

Thus Grimm's Law may be defined as the statement of certain phonetic facts which happen invariably unless they are interfered with by other facts. The great use of Grimm's Law, in addition to the identification of words in different languages, is in the detection of loan words. Any etymology which violates Grimm's Law, as qualified by other phonetic laws, must be rejected unless it can be explained as a loan word.

The causes which brought about the changes formulated in Grimm's Law are obscure. They are probably due to the settlement of Low German conquerors in central and southern Germany.

See Douse, 'Grimm's Law: a Study of Lautverschiebung' (1876), Max Müller, 'Lectures on the Study of Language,' 2d series, lecture v. (1864), Morris, 'Historical Outlines of English Accidence,' chap. ii. (1872).

Grimsel (grĭm'zĕl) **Pass,** a mountain pass in the Bernese Alps, leading from Meiringen, canton of Bern, to Obergesteln, canton of Valais. It was in this pass that the French repulsed the Austrians in 1799.

Grim'shaw, Robert, American engineer: b. Philadelphia, Pa., 25 Jan. 1850. He is lecturer in the Franklin Institute of his native city and has done much literary work. He has published: 'Saws' (1880); 'Steam-Engine Catechism' (1887); 'Records of Scientific Progress' (1891); 'Hints to Power Users' (1891); 'Fifty Years Hence' (1892).

Grim'thorpe, Edmund Beckett Denison, Lord, English barrister and author: b. Carlton Hall, Nottinghamshire, England, 12 May 1816; d. 29 April 1905. He took much interest in architecture, and designed many churches and houses, but he will be longest remembered for his restorations and rebuildings at St. Albans Cathedral, works which were carried out at his own expense, but from their iconoclastic character met with almost universal disapproval from architects and excited much discussion both in England and America. His works include: 'Origin of the Laws of Nature' (1879); 'A Book on Building' (2d ed. 1880); 'Should the Revised New Testament be Authorized?'

(1882); 'Astronomy Without Mathematics' (7th ed. 1883); 'Treatise on Clocks, Watches, and Bells' (7th ed. 1883).

Grinding, a mechanical process in which certain effects are produced by the attrition of two surfaces. This process is of extensive use in various mechanical arts, as in grinding corn, ores, colors, in which cases the object is to reduce the materials by crushing to a fine powder; or in grinding the metals, glass, and other hard substances for the purpose of giving them a certain figure or polish, or a sharp cutting edge. In the first case the grinding or crushing is effected by passing the material between rough stones, as in the common flour-mill, or as in crushing ores between heavy metal cylinders, smooth or fluted, according to the degree of fineness required, or by a heavy stone or iron cylinder revolving upon a smooth plate. Chicory, chocolate, plumbago for pencils, and a variety of other substances are ground by iron or stone rollers, revolving on a slab in such a manner that they not only merely roll but also rub on the surface of the slab. A knife or scraper follows one roller and precedes the other, scooping the paste into the position required to come fairly under the roller which follows it. Colors are ground in small quantities with a muller and slab. The muller is a heavy piece of stone of conical shape, and which rests its base on the slab and is grasped by the hands; the color is mixed to a pasty consistence with the desired medium of oil or water, and rubbed between the two surfaces until smooth and impalpable. The grinding of cutlery and tools is effected by means of the grindstone; glass lenses and metal specula are ground to shape with emery-powder laid on a metal tool. Ornamental glass is ground into facets or otherwise by means of stones and lap-wheels. Diamonds and other precious stones are cut or ground with diamond dust embedded in soft iron. Large flat surfaces are obtained by first working two pieces of the material nearly flat and then laying the one upon the other and grinding their surfaces together with sand, emery, or other cutting powder. Plate-glass is flattened in this way; also surfaces of cast-iron, where accurate fitting is required. Sockets and other bearings which require to be fitted with great nicety are usually finished by being ground together. For brass or bell-metal pumice-stone is employed in such cases, as emery is apt to embed itself in the metal and give it a permanent abrading action on the bearings. Dry grinding is the term applied to the grinding of steel with dry grindstones. The points of needles and forks are produced by this means, also the finishing of steel pens and the surface of gun barrels. The men and women engaged on this kind of work suffer painfully from irritation of the throat and nostrils caused by the fine, dust-like particles that fly off from the work. These difficulties have been mitigated in recent years by the use of mouth-pieces of damp cloth, and the provision of air-blasts to dispose of the dust. Sand-jet grinding is a remarkable process, in which abrasion is effected by the percussion of small hard particles on a plain surface. Sharp silicious sand, varying in hardness and fineness according to the kind of work to be done, is employed in most cases. This sand is impelled by a blast of steam or of air. A hole 1½ inch in diameter by 1½ deep, has been bored through a solid piece of corundum (the hardest mineral known except the diamond) in 25 minutes by sand driven with steam-power at 300 pounds pressure on the square inch. A diamond has been sensibly reduced in weight, and a topaz altogether dissipated by a sand-jet in one minute. These results are obtained by causing a sand-stream to mix with a steam jet. The sand passes through a central tube, and the steam through an annular tube which surrounds it; a kind of suction acts at the end of the concentric tubes, which draws the sand into the steam jet, and both dash with great force against the stone or other substance to be acted upon, which is placed at about an inch from the mouth of the tube. By the use of flexible jointed connecting tubes the jet can be turned in any direction, and grooves, moldings, letters, etc., can be produced instead of merely straight cuts or cavities. By using an air jet instead of steam, and varying the pressure, a design can be engraved on glass, the parts not to be acted upon being covered with the pattern, made of paper, lace, india-rubber, or oil-paint.

Grindstone Island. (1) A small island lying off the southeastern coast of New Brunswick, Canada, at the head of the Bay of Fundy It has a number of sandstone quarries, from which a fine quality of sandstone is exported, chiefly to the United States, for the manufacture of grindstones. (2) One of the most important of the Magdalen Islands, belonging to Quebec, in the gulf of St. Lawrence, northeast of New Brunswick.

Grinnell, grĭn-ĕl', **George Bird,** American writer and ornithologist: b. Brooklyn, N. Y., 20 Sept. 1849. He has been an editor of 'Forest and Stream' from 1876. His works deal principally with Indian life and folklore and among them are: 'Pawnee Hero Stories and Folk Tales' (1889); 'The Story of a Prairie People'; 'The Story of the Indian' (1895); 'The Indians of To-day' (1900); 'Jack Among the Indians' (1900).

Grinnell, Henry, American patron of arctic exploration: b. New Bedford, Mass., 1799; d. New York, 30 June 1874. In 1828 he settled in New York and amassed a fortune in business as a ship-owner. This gave him an opportunity to fit out at his own expense the ship which in 1850 sailed from New York in search of Franklin. He also bore a large part of the expense of Kane's arctic voyage (1853–55), as well as of the later American expedition under the command of Hayes and Hall. In recognition of his services to geographical science the American Geographical Society elected him their president and the coast which stretches to the north of Smith Sound was named Grinnell Land.

Grinnell, Josiah Bushnell, American clergyman and politician: b. New Haven, Vt., 22 Dec. 1821; d. Marshalltown, Iowa, 31 March 1891. After studying at Auburn Theological Seminary, he entered the Presbyterian ministry and held pastorates successively at Union Village, N. Y., Washington, D. C., and New York. In 1854 he founded the Congregational Church in Grinnell, Iowa, a town named for him, and preached there several years. Later he became known as a wool grower, sat in the Iowa senate 1856–60, and in Congress as a Republican 1863–67. He frequently aided fugitive slaves and at one time a reward was offered for his head on this account by slave-holders. He gave

much assistance to Grinnell University, of which he was president, and laid out five Iowa towns. He was the author of 'The Home of the Badgers' (1845); 'Cattle Industries of the United States' (1884).

Grinnell, Iowa, city in Poweshiek County; on the Chicago, R. I. & P., and the Iowa C. R.R.'s; 115 miles west by north of Davenport. It is the principal trade centre for the county, and manufactures flour, carriages, gloves, and some farming implements. It is the seat of the Iowa College, founded in 1848 and under the auspices of the Congregational Church. In 1882 the city was nearly swept away by a cyclone. Pop. (1900) 3,860.

Grinnell Land, a large tract of land in the Arctic Ocean, separated from Greenland by Kennedy and Robeson channels. The northern part of the explored portion is called Grant Land and the southern part Ellesmere Land. The coast is irregular, and the interior is hilly. The climate of the valleys is mild in summer; in many places there is no snow for several weeks, and vegetation grows rapidly. The fox, wolf, musk-ox, ermine, and hare are found in quite large numbers. Lieut. De Haven, an American, in charge of the Grinnell expedition in search of Sir John Franklin, first saw this land 22 Sept. 1850 and named it after Henry Grinnell (q.v.). Eight months later it was visited by Capt. Penny of the British vessel, Lady Franklin. He not knowing of the previous visit called the country Prince Albert Land. A British expedition under Narses visited it 25 years after De Haven, Greely in 1881, Lockwood in 1882, and Peary in 1898–99.

Gripe. (1) A brake applied to the wheel of a crane or derrick; it generally consists of an iron hoop under the control of a lever, and is drawn closely around the wheel to check its motion. (2) As a nautical term: (a) The fore-foot of a ship, on to which the stem is fastened; the forward end of the keel. It is scarfed to the stem piece and false keel, and is secured by a horseshoe or ring to the stem. (b) A broad plait of rope or bars of iron, with lanyard rings and claws, passing over a large boat, and by which it is secured to the ring bolts of the deck. (c) One of a pair of bands passing round a boat near the stem and stern when suspended from the davits, to prevent the boat from swinging about.

Grippe. See INFLUENZA.

Griqualand (grē'kwa-lănd) **East,** a district of Cape Colony, Africa, lying south of Natal, between Pondoland and Basutoland; area, 7,594 square miles. The capital is Kokstad. Pop. (1891) 152,618.

Griqualand West, a district of Cape Colony, Africa, bounded north by Bechuanaland, east by the Orange River colony, south by Orange River, and west by Orange River and Bechuanaland; area, 15,197 square miles. It is noted for its diamond fields which in 1870 began to attract people from other countries. The country was then claimed by the Orange Free State and by Waterboer, the Griqua chief. In 1871 Waterboer ceded all his rights to the British government, and in 1876 the Orange Free State relinquished all claim for the sum of about $440,000. In 1880 Griqualand West was incorporated as a part of Cape Colony. The chief centre of the diamond mining industry is Kimberley (q.v.), the capital. Pop. (1891) 83,375. Consult: 'Statesman's Year Book'; Reports (British) 'On the Cape and Griqualand West Diamond Mining;' Reunert, 'Diamonds and Gold in South Africa'; Williams, 'The Diamond Mines of South Africa' (1902).

Gris'com, John, American educator: b. Hancock's Bridge, Salem County, N. J., 27 Sept. 1774; d. Burlington, N. J., 26 Feb. 1852. After pursuing his studies at the Friends' Academy in Philadelphia, established by William Penn, he took charge of the Friends' monthly meeting school in Burlington, with which he was connected 13 years. In 1807 he removed to New York, and began there a career of 25 years as a teacher. In connection with his school he lectured on chemistry with much success. He took a prominent part in the formation of the society for the prevention of pauperism (1817), of which he prepared the constitution and an elaborate first report on the causes and remedies of pauperism. He was an organizer of the Rutgers Medical College, in which he occupied the chair of chemistry and natural philosophy, and after the suspension of the college was widely known as a general lecturer on those subjects. Horace Mann quoted him as one of the eight educational authorities for the changes which Mann planned to introduce into the Massachusetts school system.

Grisons, grē-zôṅ (German, *Graubünden* or *Bünden*), the largest canton of Switzerland; area, about 2,773 square miles. It is a mountainous country, more than 20 peaks being above 9,000 feet. The valleys are generally narrow, Upper and Lower Engadine are the broadest. Its chief drainage streams are the Inn, branches of the Adige and the Adda, and the Vorder and the Hinter Rhine which have their rise in this canton, and which belong to the Rhine basin. There are a large number of small lakes. Snow rests on the mountains until the last of May and sometimes into late July, but the climate of the valleys is warm or temperate nearly all the year. Agriculture in the valleys and the raising of cattle and sheep on the mountain sides are the chief occupations. Pop. (1900) 104,510.

Griswold, grĭz'wōld, **Alexander Viets,** American Protestant Episcopal bishop: b. Simsbury, Hartford County, Conn., 22 April 1766; d. Boston, Mass., 15 Feb. 1843. After studying for the ministry he was ordained in 1795. He was rector of St. Michael's Church, Bristol, R. I., 1804–30 and of St. Peter's, Salem, Mass., 1830–35. When what was known as the eastern diocese of the Episcopal Church was organized he was consecrated its first bishop in 1811. He published 'The Reformation and the Apostolic Office' (1843). See Stone, 'Memoirs of Bishop Griswold' (1844).

Griswold, John Augustus, American manufacturer: b. Nassau, Rensselaer County, N. Y., 1822; d. 1872. At Troy, N. Y., he was active successively in the hardware, drug, and iron trades, and established the Albany and Rensselaer Iron and Steel Company. He was a leader in the introduction of Bessemer steel manufacture into the United States, and with C. H. Delamater built the Monitor of Civil War fame. In 1855 he was elected mayor of Troy, in 1863 a Democratic representative in Congress, and sub-

sequently was twice re-elected as a Republican. In 1868 he was nominated for the governorship of New York, but defeated by the Democratic nominee, J. T. Hoffman.

Griswold, Matthew, American jurist: b. Lyme, Conn., 25 March 1714; d. there 28 April 1799. Besides being lieutenant-governor of Connecticut 1771–84, he was governor 1784–85 and became judge of the supreme court in 1769. He also presided over the convention which ratified the Federal Constitution.

Griswold, Roger, American politician: b. Lyme, Conn., 21 May 1762; d. Norwich, Conn., 25 Oct. 1812. He was graduated from Yale College in 1780, and afterward studied and entered on the practice of law. He was a member of Congress, 1795–1805, and became judge of the Connecticut supreme court in 1807. He was lieutenant-governor of his native State, 1809–11, and governor 1811–13. He was a son of Matthew Griswold (q.v.).

Griswold, Rufus Wilmot, American author and compiler: b. Benson, Rutland County, Vt., 15 Feb. 1815; d. in New York 27 Aug. 1857. He was apprenticed to the printing trade, but afterward studied divinity and became a preacher in the Baptist Church. He soon became associated in the editorship of literary periodicals in Boston, New York, and Philadelphia, among which were the 'New Yorker,' 'Brother Jonathan,' and the 'New World.' In 1842–43 he edited 'Graham's Magazine,' in Philadelphia, to which he attracted contributions from some of the best writers in the country, and in 1850 projected the 'International Magazine,' published in New York, and edited by him till April, 1852. The works by which he is chiefly known are collections of specimens from American authors, accompanied by memoirs and critical remarks. His published works include: 'Poets and Poetry of America' (1842); 'Prose Writers of America' (1846); 'Female Poets of America' (1849); 'Sacred Poets of England and America' (1849); 'Poets and Poetry of England in the Nineteenth Century' (4th ed. 1854); 'Curiosities of American Literature,' 'Washington and the Generals of the American Revolution,' with Simms, Ingraham, and others (1847), 'Napoleon and the Marshals of the Empire,' with Wallace (1847); 'Republican Court, or American Society in the Days of Washington' (1854). He edited the first American edition of the prose works of Milton (1845), and was one of the editors of the works of Edgar A. Poe, for whose bad repute Griswold's 'Memoir' is partly responsible.

Griswoldville, Battle of. When General Sherman marched from Atlanta to the sea, his right wing, commanded by Gen. Howard, was under instructions to threaten Macon and strike the Savannah Railroad at Gordon, about 20 miles east. Upon his arrival at Clinton, the cavalry advance made a demonstration on Macon, and 21 Nov. 1864, his entire cavalry force took up an advanced position covering all the roads to Macon, and that day and the next all the troops and trains were closed up toward Gordon, except C. R. Woods' division, which was directed to take up a strong position on the Irwinton road and demonstrate on Macon and Griswoldville, eight miles east. The demonstration was made on the 22d by Walcutt's brigade of 1,513 men and two guns, in co-operation with Kilpatrick's cavalry on the different roads. Some of Kilpatrick's cavalry were in advance of Walcutt and were fiercely attacked by Wheeler; but with Walcutt's assistance Wheeler was driven from the field, and followed by Walcutt beyond Griswoldville. Walcutt was then recalled to a position a little east of Griswoldville, where two miles in advance of his division, he formed line along a slight rise of ground, with his flanks well protected by swampy ground, and with an open field in front. Kilpatrick's cavalry was on either flank. Walcutt had scarcely thrown up a rail barricade, in view of another attack of Wheeler's cavalry, when he was fiercely assailed by infantry. That morning, under Gen. Hardee's order, Gen. G. W. Smith, in command of a considerable body of Georgia militia that had been concentrated at Macon, directed Gen. Phillips, with a division of infantry and a battery, to march from Macon to Gordon and take trains for Augusta. Phillips had been instructed to halt before reaching Griswoldville and wait for further orders, and was cautioned not to engage an enemy if met, but to fall back to the fortifications at Macon. But when he heard of Walcutt's position he moved through Griswoldville and, with more courage than discretion, threw his four brigades against Walcutt, at the same time opening destructively with his artillery. At 2 o'clock, in three compact lines, his militia charged to within 75 yards of Walcutt's line, and were repulsed. The assaults were repeated in front and on both flanks, and continued until sunset, when, everywhere repulsed, he abandoned the field, leaving his dead and wounded. During the action Walcutt was severely wounded by a piece of shell. The Union loss was 13 killed, 69 wounded, and 2 missing. The Confederate loss was 51 killed and 472 wounded. Consult: 'Official Records,' Vol. XLIV.; Cox, 'The March to the Sea'; the Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. Carman.

Griv'et. See Green Monkeys.

Groesbeck, groos'běk, **William Slocomb,** American politician: b. New York, 1815; d. 1897. He was graduated from Miami University, Oxford, Ohio, in 1835, studied law and began practice at Cincinnati. In 1851 he was a member of the Ohio State constitutional convention, and in 1852 a member of the commission appointed for the codification of the State laws. From 1857 to 1859 he was a Democratic representative in Congress, in 1872 was nominated for the Presidency by the Liberal Republicans but met no recognition in the ensuing campaign, and in 1878 was United States delegate to the International Monetary Congress at Paris. He defended Andrew Johnson in the latter's impeachment trial (1868).

Groin, the region where the front of the thigh joins the body. The abdominal muscles end below in a strong tendon which makes a fold across the front of the bony pelvis. The large nerves, arteries, and veins pass through folds of this ligament, and portions of the abdominal contents in case of rupture pass into the scrotum or form a tumorous swelling in the groin.

Gronlund, grŏn'lŭnd, **Lawrence,** American socialist: b. in Denmark 1847; d. 1899. He studied in the University of Copenhagen, in 1867 came to the United States, practiced law for a time, but became a writer and speaker on socialism. Among his publications are 'The Coming Revolution' (1880), a forecast of the peaceful changes which he believed might be effected by a national organization operating in every community; 'Ça Ira,' a rehabilitation of Danton (1888); and 'The New Economy' (1898).

Gronovius, grō-nō'vĭ-ŭs (properly GRONOV, grō'nōv), the name of several Dutch classical scholars:

(1) JOHANN FRIEDRICH, yō'hän frēd'rih: b. Hamburg 8 Sept. 1611; d. Leyden, 28 Dec. 1671. He studied at Leipsic and Jena, and law at Altdorf, was appointed professor of history and eloquence at Deventer (1642), and, after the death of Heinius, succeeded him as professor of belles-lettres at Leyden (1658). His editions of Livy, Statius, Justin, Tacitus, Aulus Gellius, Phædrus, Seneca, Sallust, Cicero, Terence, Pliny, and Plautus, 'Observationes' (1639), and edition of Hugo Grotius' work, 'De Jure Belli et Pacis' (1642) are justly valued on account of the notes.

(2) JAKOB, yä'kōb, son of the preceding: b. Deventer, 1645; d. Leyden, 21 Oct. 1716. He studied at Deventer and Leyden, and published, in 1676, an edition of Polybius, which met with great applause. He received from the grand duke of Tuscany a professorship at Pisa, which he relinquished in 1679 to become professor of Greek literature and history at Leyden. This learned critic edited Tacitus, Polybius, Herodotus, Pomponius Mela, Cicero, Ammianus Marcellinus and other classical writers, and compiled the valuable 'Thesaurus Antiquitatum Græcarum' (1698–1702). He also promoted the publication of the collections of Grævius. He was a violent controversialist.

Groot, grōt, **Groete,** or **Groote, Gerhard** or **Gerardus,** founder of the Brothers of the Common Life (q.v.): b. Deventer 1340; d. there 20 Aug. 1384. Educated at Paris, he there became a teacher, later took deacon's orders and was successful as a traveling preacher. He advocated general reading of the Scriptures, assembled a company for the preparation of copies of the Bible, and thus began the formation of the Brothers of the Common Life. To this order, which obtained papal sanction in 1418, belonged Thomas à Kempis (q.v.). Groot was the author of several works.

Gros, Antoine-Jean, äṅ-twän zhŏṅ grō, BARON, French historical painter: b. Paris 16 March 1771; d. near Paris, 26 June 1835. At 14 he became a pupil of David, and in 1794 left Paris for Rome. His means, however, were not sufficient for the journey, and he had to depend on what he could earn as a portrait-painter in the various towns he passed through. At Genoa, in 1796, he was drawn for the French army, and soon became a staff-officer. Josephine, afterward empress of France, saw and admired several portraits by the young officer, and he was called upon to paint that of Bonaparte. The result was a picture representing Napoleon leading his troops over the bridge of Arcola. In 1804 he produced his 'Peste de Jaffa,' considered by many to be his masterpiece. He painted the 'Bataille d'Aboukir' (1806); 'Bataille d'Eylau' (1808); 'La Prise de Madrid,' 'Wagram,' and 'La Bataille des Pyramides' (1810). In France his chief work is considered by some to be the cupola of St. Geneviève at Paris, exhibiting the saint protecting the throne of France, represented by Clovis, Charlemagne, St. Louis, and Louis XVIII. This picture covers an immense space, and is correct in design but defective in color and expression. The artist received for it 100,000 francs and the title of baron. The rise of the romantic school bore away from him the tide of popularity, and his last work 'Hercule et Diomède,' was a failure. Adverse criticisms upon it brought on a fit of despondency and he drowned himself in the Seine.

Gros Ventres, grō väntr (Fr. «big bellies»). (1) The Minnetari or Hidatsa Indians, on the Missouri River. (2) A band of the Arapaho, who separated from the main body about 1800: the name was a misunderstanding of their own term, which meant «hungry men» or «beggars.» After conflicts with the Sioux, and being plundered by the Crows, whom they had joined, they settled among the Blackfeet near Milk River about 1824; prospered, and were very hostile to the whites. About 1830 they had some 400 lodges and 3,000 souls. But about 1866 they were decimated by the measles, and thus weakened, received a terrible defeat from the Piegans; reduced to about 1,300 by smallpox in 1870, they were plundered and many killed by the Sioux. Later they were joined by the main body of Arapaho and Cheyennes. In 1868 they were settled among the Blackfeet in Montana.

Grosbeak, grōs'bēk, any of various birds whose beaks seem disproportionately large. They are mainly finches such as the hawfinch and bullfinch in Europe, and their relatives in the Orient. Bird-dealers call «grosbeaks» a great number of African, Asiatic and American line cage-birds, some of which are weaver-birds, or tanagers, etc. The term is more exactly given to certain North American fringilline birds with big swollen bills, such as the cardinal (q.v.), the evening grosbeak (q.v.), and the pine, blue, rose-breasted, and black-headed grosbeaks. The pine grosbeak (*Pinicola enucleator*) is a greenish yellow finch which dwells exclusively in the coniferous forests of northern Europe and America, and is only seen in the United States when forced southward by hard winters; it feeds on the seeds of the pine, spruce, etc., wrenching open the cones with its powerful beak. The blue grosbeak (*Guiraca cærulea*) is a large, richly blue southern and western bird, nearly related to the indigo-finch, which makes its nest in a bush, and lays pale blue eggs, wholly unmarked. The rose-breasted and black-headed grosbeaks represent the genus *Zamelodia*, the former (*Z. ludoviciana*) in the Eastern States, and the latter (*Z. melanocephala*) in the Rocky Mountain region. Both are birds of brushy places, making large, rude nests in bushes and laying greenish, heavily marked eggs; and in the breeding-season both are among the loudest and most brilliant of American song-birds. As in nearly all the grosbeaks the females of these species are inconspicuous in brown tints, while the males are dressed in gay colors. The male rose-breasted has the head, neck and upper parts mostly black, with the rump, wings, tail and abdomen, white; while the breast and lining of

the bend of the wing are exquisite rose-red, which the bird is fond of displaying. The male black-head has a wholly black head and upper parts, set off by a collar and other marks of dull orange, which color also suffuses the whole lower parts.

Grose, grōs, **William**, American soldier and politician: b. Dayton, Ohio, 1812; d. 1900. He resigned his position as judge of the court of common pleas in 1861 to recruit and take command of the 36th Indiana regiment of infantry, and commanded a brigade in the battles of Murfreesboro, Chickamauga, and Chattanooga. He was commissioned brigadier-general 30 July 1864 and at the battle of Nashville, 15 and 16 Dec. 1864, he commanded the Third brigade in General Thomas's army. In 1865 he was brevetted major-general of volunteers. He was State senator from 1879 to 1883.

Gross, grōs, **Charles**, American historian: b. Troy, N. Y., 10 Feb. 1857. After graduating from Williams College in 1878, he pursued his studies at Göttingen, and was engaged in literary work in England 1884–87. Since 1888 he has been instructor and professor of history at Harvard University. A frequent contributor to the 'American Historical Review' and other historical journals, he has published: 'Gilda Mercatoria' (1883); 'The Exchequer of the Jews of England in the Middle Ages' (1887); 'The Gild Merchant' (1890); 'Select Cases from the Coroner's Rolls' (1896); 'Bibliography of British Municipal History' (1897); 'Sources and Literature of English History' (1900). In addition he has translated: Lavisse's 'Political History of Europe' (1891); Kayserling's 'Christopher Columbus' (1893).

Gross, Samuel D., American physician and surgeon: b. Northampton County, Pa., 8 July 1805; d. 6 May 1884. He began the practice of medicine in Philadelphia, devoting his leisure to study and to the translation of French and German medical works. His first original work was a treatise on the 'Diseases and Injuries of the Bones and Joints' (1830), in which occurs the first account of the use of adhesive plaster as a means of extension in the treatment of fractures. In 1835 he became professor of pathological anatomy in the medical department of the Cincinnati college, where he delivered the first systematic course of lectures on morbid anatomy that had ever been given in this country, and composed the first systematic treatise upon the subject ever published in the United States, 'Elements of Pathological Anatomy (1839). In 1840 he became professor of surgery in the University of Louisville. Besides the works already mentioned, he was the author of a monograph on 'Wounds of the Intestines' (1843); 'Diseases, Injuries, and Malformations of the Urinary Organs' (1851); 'Foreign Bodies in the Air Passages' (1854); 'System of Surgery, Pathological, Diagnostic, Therapeutic, and Operative' (2 vols. 1859).

Grosse, Julius Waldemar, German poet, dramatist, and novelist: b. Erfurt, Prussia, 25 April, 1828; d. 1902. After obtaining his education at Halle, he entered the field of journalism, for 16 years (1854–70), being associated with the *Neue Münchener Zeitung* (afterward known as the *Bayrische Zeitung*), and in 1870 becoming secretary of the Schiller-Stiftung, at Weimar. His writings are various, including novels, dramas, epics, songs, and ballads, the most important of which are his war songs, 'Wider Frankreisch' (1870); 'Das Volkramslied' (1889); 'Gundel von Königssee,' and 'Das Mädchen von Capri,' all epic poems; 'Pesach Pardel' (1871); 'Hilpah und Shalum,' and 'Der Wasunger Not' (1872), comic epics; the dramas, 'Tiberius' (1875), and 'Fortunat' (1895); the novels, 'Ein Revolutionär' (2d ed. 1871), and 'Tante Carldora,' and several tales and romances, among which is 'Die Novellen des Architekten' (1896).

Grosseteste, Robert, English Roman Catholic prelate: b. Stradbrook, Suffolk, about 1175; d. Buckden, 9 Oct. 1253. He studied law, physics, and theology at Oxford and Paris, and, upon his return to England, attained an enviable reputation as a theologian, so much so that in 1214 he became archdeacon of Wifts, and in 1224 received the directorate of theology and became first *rector scholarum* of the Franciscan school at Oxford. In 1232 he took up the cause of the Jews against the king, defending them with great vigor, and in 1235 was elected Bishop of Lincoln, whereupon he undertook to make radical changes in his diocese and eliminate some of the many abuses prevalent there, the result of which was that though he was possessed of great force of character, his high temper and lack of tact and diplomacy led him into innumerable controversies. The most famous of these was with Pope Innocent IV., who, desiring to fill the lucrative positions in the church with Italians and Provençals, in 1253 sent the Bishop a request that he appoint his (the Pope's) nephew to the first vacant canonry in the cathedral of Lincoln. This Grosseteste flatly refused to do, and, as his clergy stood by him in his fight against this abuse, the matter was finally dropped and it is mainly upon this incident that his fame rests. He was, though, a man of great scholarly attainments, Hebrew, Latin, Greek, French, mathematics, medicine, and music being numbered among them, beside which he was one of the most learned preachers of his time and a voluminous writer. Consult: Perry, 'Life' (London 1871); Luard (editor), 'Roberti Grosseteste Episcopi quondam Lincolniensis Epistolæ' in the Rolls Series (1862).

Grossi, Tommaso, Italian poet and novelist: b. Belluno, on the Lake of Como, 20 Jan. 1791; d. Milan, 10 Oct. 1853. He studied law at Pavia and settled in Milan, where he passed the remainder of his life as a notary, but his political ideas prevented his rise in his profession. His first attempt at poetry was 'La Principe,' written in the Milanese dialect, and this was followed in 1816 by two shorter poems, 'La Fuggitiva' and 'La Pioggia d'Oro,' and in 1820 by 'Ildegonda,' a romance in verse. This poem became popular and set the fashion for that style of writing, the success which it attained encouraging him to write 'I Lombardi alla Prima Crociata' in 1826, a poem remarkable for its patriotic sentiment. Despite the fact that Manzoni gives praise to this last poem in his novel 'I promessi sposi,' and that the cost of printing was defrayed by a generous subscription, it was soon forgotten. This did not dishearten him, however, and in 1834 he published his 'Marco Visconti,' which at once excited public approval and became the pioneer of the

historical novel in Italy. His only other work of note was 'Ulrico e Lida,' published in 1837.

Grosso, Matto, mä'tō grō'sō, Brazil (q.v.), a western central state bordering on Bolivia, Argentina, and Paraguay. It has an area of 532,500 square miles and an estimated population in 1900 of 157,000. Capital Cuyabá (q.v.).

Grosvenor, grō'vē-nôr, **Edwin Augustus,** American educator and author: b. Newburyport, Mass., 30 Aug. 1845. He was graduated at Amherst College in 1867 and at Andover Theological Seminary in 1872, was professor of history at Roberts College, Constantinople, in 1873–90; and of European history at Amherst College in 1892–9. In 1899 he was appointed to the newly established chair of modern governments and their administration. His publications include translations from the French of Victor Duruy's 'Modern Times' (1894) and 'General History' (1898); 'The Hippodrome of Constantinople' (1889); 'Constantinople' (1895); 'The Permanence of the Greek Type' (1897); and 'Contemporary History' (1899), extending from 1848 to the present time.

Grote, George, English historical writer: b. Clayhill, Kent, 17 Nov. 1794; d. London, 18 June 1871. After having studied at the Charterhouse, in 1809, he became a clerk in his father's banking house. He kept on with his studies, particularly with philosophy, and his liberal trend of thought gradually drew him into politics. He had written and spoken much in favor of the Reform Bill which was passed in 1832, and in that year he was elected to the House of Commons from London, which seat he continuously occupied until 1841. During all these years he had steadily worked upon his 'History of Greece,' the idea of which was suggested to him by the spirit of partiality displayed in Mitford's 'History of Greece' and which he had severely criticised in an article in the *Westminster Review* (April 1826). He had as early as 1823 devoted himself to the study of Greek history, for a sympathetic interpretation of which his extreme liberality made him admirably suited, and though to a certain extent the spirit of democracy is evident in the 'History of Greece,' yet the facts are placed before the reader with the idea that he will form his own conclusion. His private and public duties had prohibited literary work and it was not until he retired that he completed the first two volumes which appeared in 1845, the last volume of the set, the twelfth, appearing in 1856. Grote also wrote 'Plato and the Other Companions of Socrates' (3 vols., 1865); 'Minor Works,' edited by Alexander Bain (London 1873), and 'Aristotle,' which he left unfinished (2 vols., 1872). He had taken an active interest in educational matters, in 1860 becoming vice-chancellor of the London University, and in 1869 president of the University College, and also was elected a trustee of the British Museum. Consult: Mrs. Grote, 'Memoirs' (London, 1873); Alexander Bain, 'Character and Writings of G. Grote,' prefixed to his 'Minor Works' (London, 1873).

Grotefend, Georg Friedrich, German archæologist and philologist: b. Münden, near Cassel, Prussia, 9 June 1775; d. Hanover, 15 Dec. 1853. He received his early education at Hanover and Ilfeld, and completed his studies at the University of Göttingen (1795–7). He became prorector and later conrector of the gymnasium at Frankfort-on-the-Main (1803–21), and for nearly 30 years (1821–49) was director of the lyceum at Hanover. His research in the field of Latin philology was of great value, but his importance is chiefly due to the fact that he first deciphered the old Persian inscriptions of Persepolis, presenting the results of his labors in a paper before the Academy of Science at Göttingen, 4 Sept. 1802. Chief among his publications are: 'Rudimenta linguæ Umbricæ' (1835–8); 'Neue Beiträge zur Erläuterung der babylonischen Keiliuschrift' (1840); 'Zur Geographie und Geschichte von alt-Italien' (1840–2); 'Rudimenta Linguæ Oscæ (1839), etc.

Grotius (gro'chi-us), or De Groot, Hugo, Dutch scholar and statesman: b. Delft 10 April 1583; d. Rostock 28 Aug. 1645. He was a pupil of Joseph Scaliger at the University of Leyden, conducted his first lawsuit in his 17th year; and in his 24th was appointed advocate-general. In 1613 he became syndic, or pensionary, of Rotterdam. In 1615 he was sent to England in order to arrange the difficulties arising from the claims of the English to exclude his countrymen from the Greenland whale-fishery. He declared himself on the side of Barneveldt (q.v.) in the struggle between the Remonstrants and their opponents, and was sentenced to imprisonment for life in the fortress of Loevenstein. He succeeded in escaping by concealing himself in a chest, and after wandering about for some time in the Catholic Netherlands escaped to France, where Louis XIII. gave him a pension of 3,000 livres, withdrawn in 1631. He returned to Holland, but by the influence of enemies, was condemned to perpetual banishment. He later went to Hamburg, and in 1634 to Stockholm, where he was appointed counsellor of state and ambassador to the French court, in which post he remained for ten years. On his return to Sweden by way of Holland he met, in Amsterdam, with a distinguished reception. Most of his enemies were dead, and his countrymen repented of having banished the man who was the honor of his native land. With the talents of the most able statesman, Grotius united deep and extensive learning. He was a profound theologian, excellent in exegesis, his 'Commentary on the New Testament' being still esteemed; a distinguished scholar, an acute philosopher and jurist, and a judicious historian. His writings have had a decisive influence on the formation of a sound taste, and on the diffusion of an enlightened and liberal manner of thinking in affairs of science. As a critic and philologist he seizes the genius of an author with sagacity, illustrates briefly and pertinently, and amends the text with facility and success. His metrical translations from the Greek are executed with the spirit of a poet. Among the modern Latin poets he holds one of the first places, and he also tried his powers in Dutch verse. But the philosophy of jurisprudence has been especially promoted by his great work on natural and national law, 'De Jure Belli et Pacis,' which represented the study of twenty years and laid the foundation of the new science of international law; besides which he wrote 'Annales et Historiæ de Rebus Belgicis' (1657); 'Annotationes in Vetus Testamentum'

(1644); 'Annotationes in Novum Testamentum' (1641-46). 'De Veritate Religionis Christianæ, and Poemata' (1617). See Butler, 'Life of Hugo Grotius' (1826); Hély, 'Etude sur le Droit de la Guerre et de la Paix de Grotius' (1875).

Gro'ton, Conn., town in New London County; on the Thames River, the New York, N. H. & H. railroad; opposite New London. In 1637 Capt. Mason stormed the fortress held by the Pequots, and many lives were lost, both whites and Indians. A more disastrous fight occurred here 6 Sept. 1781, when 800 British troops under Benedict Arnold attacked Fort Griswold (q.v.), which was garrisoned by 150 soldiers. The Americans heroically resisted, but were overwhelmed by numbers, and Arnold and his force entering the fort butchered 85 men and wounded 65. Soon after 35 of the 65 died from the effects of their wounds. This battle is known in history as the "Massacre of Fort Griswold." Groton contains ship-building yards, several manufactories, and the Bill Memorial Library. Consult: Caulkins, 'The Stone Records of Groton' (1903); 'History of New London County'; 'Magazine of American History,' 'The Massacre of Fort Griswold.'

Grouchy, groo-shē, **Emmanuel,** Marquis de, French marshal: b. Paris 23 Oct. 1766; d. St. Etienne 29 May 1847. He acquired distinction in the revolutionary armies, and in the campaign of 1800 fought in the army of the Rhine under Moreau, and rendered important service at the battle of Hohenlinden. In the war with Prussia in 1806, and with Russia in 1807, he acquired new fame, and was sent to the army of Italy under Prince Eugene. At the battle of Wagram his masterly manœuvres contributed greatly to the victory. On the restoration he was banished, but allowed to return in 1815. On Napoleon's return from Elba he immediately joined him, was made a marshal, and obtained first the command of the army of the Alps, and then the command of the cavalry in the grand army. After the battle of Ligny he was sent on the following day with 34,000 men and 100 cannon to follow the retreat of the Prussian army under Blücher. While he here on the 18th engaged with Thielemann, Napoleon gave battle at Waterloo, the disastrous issue of which has been sometimes laid to Grouchy's charge, from having failed to observe how three divisions of the Prussian army were advancing to Waterloo to take Napoleon in flank and rear, while Thielemann alone remained at Wavres. Being again banished, he came to the United States, where he lived five years, but was permitted to return in 1819. After the July revolution he was elected to the chamber of deputies by the department of Allier, supported the new dynasty, and was appointed in 1831 marshal, and in 1832 a peer.

Ground Beetles. The family *Carabidæ,* predatory beetles of various sizes and appearance. It contains upwards of 1,200 described species, nearly all of nocturnal habit, and, consequently, dark, mostly black in color. Some species, however, are metallic green or blue, or beautifully variegated. The family contains many beneficial species, which roam fields, meadows and gardens, destroying many injurious pests. They fly freely at night, and seek concealment in the daytime under stones and logs and in other convenient hiding-places. Most species are terrestrial, but a few forms, such as species of *Calosoma,* known as 'caterpillar-hunters,' climb the trunks of trees in search of noxious caterpillars which they destroy. A remarkable genus is that of the bombardier beetles (q.v.). A very few are occasionally injurious, among them *Agonoderus pallipes,* which burrows into newly planted seeds of corn; and two species of *Harpalus* which are destructive to strawberries. These latter insects are interesting because of their dual habit of being carnivorous as well as herbivorous. They attack, in the beetle stage, the seeds of Ambrosia, and also eat insects of various kinds.

Ground-cherry, herbaceous plants of the potato family, constituting the genus *Physalis,* scattered through most of the world. About 35 species are natives of the United States, and some are known as 'tomato strawberries,' and are cultivated for the sake of their berry-like fruit, which is hidden within a persistent red calyx.

Ground Cuckoo, a coucal (q.v.).

Ground-dove, any of various species of pigeons which live mainly on the ground and seek their food there. The name is especially given to the genus *Columbagallina,* small birds of the warmer parts of America, of which one gentle and familiar species (*C. passerina*) is well known in the South Atlantic States, along the coast. The bronze-wing pigeons of Australia, and the large pigeons of the genus *Goura* (q.v.) are also so called.

Ground Ivy, a familiar European labiate plant (*Glechoma hederacea*), allied to mint, with a creeping stem and purple flowers. The leaves are crenate-reniform and the flowers are in threes. It was formerly employed to flavor ale and also medicinally.

Ground-nut, a climbing plant (*Apios apios*) of the pea family, which puts out dense clusters of dull purple flowers after most other plants have stopped blooming; these are velvety within and sweetly fragrant. The tuberous rootstock is edible, whence the name.

Ground-rent, in law, is the rent paid to the landlord by a person for the use of ground on which he intends to build. The usual arrangement is for a specified time, generally for a period of ninety-nine years. On the expiry of this period the whole of the building becomes the property of the ground-landlord. The ground-landlord is able, when his rent is in arrear, to distrain all the goods and chattels found on the premises, to whomsoever they may belong; and as the ground-rent is generally a small sum compared with the furniture of a tenant, he is always certain of recovering its full amount. This power of distress exists whether the tenant has paid his house-rent to his landlord or not, but the tenant may deduct the amount from the next rent he pays. See Landlord; Rent; Tenant.

Ground-sloths, a family (*Megatheriidæ*) of extinct edentates, related to the modern sloths, but of terrestrial habits, and, in respect to many of them, of gigantic size, which are of special interest because some survived into the human period. They exhibit the head and teeth of a sloth, associated with the vertebræ, limbs and tail of an ant-eater. They were chiefly South American, but spread as far as North America

in the Pliocene and Pleistocene epochs, and became extinct in very recent, but probably prehistoric times. *Megatherium* (q.v.) is the largest and most familiarly known genus; it almost equalled an elephant in size, and surpassed one in its massive proportions. *Lestodon, Mylodon* (q.v.), *Scelidotherium*, and *Megalonyx*, were smaller but more common forms. The discovery of part of the hide of one of these animals, genus *Glossotherium*, in a cave at Last Hope Inlet, Patagonia, showed that their skin was thick, studded with small embedded bony nodules, and thickly covered with long, coarse, yellowish-brown hair, as well preserved as are the feathers of the moas in New Zealand. The skin, says the discoverer, Dr. Moreno, of Buenos Ayres, shows patches of red color, suggesting of course blood-stains; and when small bits were chemically analyzed they yielded serum and the substances of glue. In view of this it seems impossible to believe that the skin can be of any great age, for bacteria would have finished their work upon the serum and gelatine long ago. An equally fresh-looking skull was found, as though in a small stone enclosure, and wounded in such a way as only man could have inflicted; and there are legends among the Indians that such creatures were known to their ancestors. Dr. Moreno is of the opinion, from evidences found in this cave and elsewhere, that these animals had been domesticated by man, but to what extent and for what purposes is unknown.

Consult Beddard, 'Mammalia' (1902), where further references are cited.

Ground-snake, one of the little, burrowing worm-shaped snakes of the genus *Carphophiops*, which abound in tropical America. One species (*C. amœnus*) is numerous under stones and logs in the Southern States, and is glistening chestnut in color above and salmon-yellow beneath. A larger, more purplish species (*C. vermis*) is called "ground-worm" in Louisiana. These snakes are perfectly harmless, and are the least specialized of the *Colubridæ*.

Groupers (Anglicized form of Spanish name "Garrupa"). Tropical and semi-tropical sea-bass of the genera *Epinephelus, Promicrops, Mycteroperca* and their allies. All are valuable food-fishes and most of them of large size, bright coloration and high quality as game-fishes. About a dozen species enter the waters of the Southern States or California, the most common along the Atlantic coast being the red grouper (*E. morio*), called "Cherna" and by many other local names. It is a large fish (20 to 40 pounds), is particularly abundant on the west coast of Florida, keeps near the bottom and is a voracious carnivore, consuming large quantities of small fishes, as well as crabs, etc. It is a favorite with market-fishermen, because it bears so well the hardships of transportation. The yellow-finned grouper or rockfish (*M. venenosa*); yellow grouper (*M. olfax*); and black grouper of the Florida Keys (*M. bonaci*), are also large and important; while another black grouper (*Promicrops*) is the famous jewfish (q.v.) of sportsmen. Several other species are elsewhere described under particular names, as CABRILLA, MERO, SCAMP, etc. Consult 'American Food and Game Fishes,' by Jordan and Evermann (New York 1902).

Groups, Theory of. Everywhere in mathematics are encountered systems of *operations*, possessing definite laws of combination. Thus, two geometric motions compound into a single motion, two algebraic transformations into a single transformation, under laws as definite as the primordial 2×2 of arithmetic but otherwise capable of infinite variety of simplicity and intricacy. Consider, for example, the 12 rotations of a regular tetrahedron into itself. Any two of these rotations compound into a third one among them, easily identified on a model. By a simple convention, these various combinations can be registered in algebraic form. The several rotations may be designated by the marks $a, b, c, \ldots$; the symbol ab may indicate that a is followed by b, and at the same time designate their resultant effect. This resultant ab is called the *product* of a and b in the order written; it is itself one of the 12 rotations, say c, and we write $ab = c$. It is an instructive exercise to tabulate the products of two or more of the 12 rotations, identifying each product with one of the 12 original rotations. It is possible to express all the 12 rotations as products of two of them, say of the rotation a through 120° about an axis through one of the four vertices of the tetrahedron and the rotation b through 180° about an axis joining the middle points of two opposite edges. It may be noted that the products ab and ba are here not the same rotation: a and b are not *commutative* as in ordinary algebra. On the other hand aa, which is a rotation through 240° about the axis of a, is conveniently denoted by a^2; a^3 and b^2, both of which restore every point to its initial position, may appropriately be equated to 1 (identity), which is included among the 12 rotations. The three rotations b_1, b_2, b_3 about the (trirectangular) axes joining the middle points of opposite edges of the tetrahedron will be found to be commutative; in fact $b_1b_2 = b_2b_1 = b_3$, $b_2b_3 = b_3b_2 = b_1$, $b_3b_1 = b_1b_3 = b_2$; $(b_1^2 = b_2^2 = b_3^2 = 1)$.

The tetrahedral rotations furnish a simple instance of an *algebra of operations*. Any system of operations possesses such an algebra, of greater or less extent. And as many different systems of operations, taken from widely separated mathematical fields, often present one and the same algebra, these algebras are worthy of study by themselves, as generalizing and unifying instruments. Since each algebra is completely defined by the laws of combination of the symbols $a, b, c, \ldots$, we may abstract the idea of operation entirely and deal with the pure algebra. This position having been reached, it is inevitable to the mathematical mind to reverse the order of thought and to devise algebras *à priori*, leaving their concrete interpretation for secondary consideration. In constructing such algebras, choice among the infinite possibilities will be dominated by the two principles of generality and usefulness. The two qualities are combined in high degree in the algebra of *groups*.

Definition of Group.—A system of symbols, or *elements*, $a, b, c, \ldots$ (finite or infinite in number), conceived as capable of multiplication with each other, is said to form a *group* if the following conditions are fulfilled:

(1). The product of any two elements of the system is a third element of the system.

(2). The multiplication is associative: $(ab)c = a(bc)$, (but not necessarily commutative: ab and ba need not be equal).

(3). Equalities $ab = ab'$ or $ab = a'b$ require $b = b'$ or $a = a'$, respectively.

(Conditions (2) and (3) evidently hold for any ordinary kind of *operations;* (1) traces a significant boundary).

The *order* of a group is the number n of its elements. A group is briefly called finite or infinite, according as its order is finite or infinite.

The defining conditions (1)–(3), classic in their simplicity, possess a most extraordinary fecundity. From them alone proceed, by pure logical deduction, the vast and intricate systems which make up the algebra of groups.

As a primary deduction it may be noted that every finite group G contains one and only one element, identity (denoted by 1), such that for every element x of G $1x = x1 = x$. A proper power x^m of any element x of G is equal to this element 1; the lowest exponent m for which this is true is called the order of x; every power of x is equal to one of the m powers $x, x^2, x^3, \ldots, x^{m-1}$, 1. The *inverse* x^{-1} of x is defined by $x^{-1}x = 1 = x^{m-1}x$, whence by (3) $x^{-1} = x^{m-1}$; then $x^{-2} = (x^2)^{-1} = x^{m-2}$, etc. The analogy to ordinary algebra (of mth roots of unity) is here perfect. These elementary principles may be illustrated by reference to the tetrahedral group G of order 12 above.

An infinite group does not necessarily contain the element 1 nor the inverse elements. Thus all the motions of a point along a line in *one* direction form an infinite group, but this does not contain the reverse motions nor the case of no motion. The prevailing tendency is, however, to restrict the name group to systems which contain the inverse of their elements, and consequently the element 1.

A part of the elements of a group G, taken by themselves, may form a group H, which is then called a *subgroup* of G. Thus the powers of any element x of G form a cyclical group H which is either G itself or a subgroup of G. The tetrahedral group has a subgroup of order 4 composed of b_1, b_2, b_3 and identity. The order h of a subgroup H of G is always a divisor of the order g of G. If p^i, where p is a prime number, is a divisor of g, G has one or more subgroups of order p^i, and the total number of these subgroups is of the form $kp + 1$, where k is an integer. If p^a is the *highest* power of p that divides g, $kp + 1$ is also a divisor of g. These theorems of Sylow and Frobenius are of great assistance in the analysis of groups of finite order. Thus a group of order pq, where p and q are prime numbers, has a single subgroup of order p; it has also a single subgroup of order q, unless p is of the form $kq + 1$. Thus the order $15 = 5.3$ presents only one case, while the order $21 = 7.3$ presents two. For a further example, the icosahedral group of rotations, which is of order 60, contains subgroups of orders, 2, 4, 3, 5, and also 6 and 10. The 15 lines joining middle points of opposite edges of the icosahedron form five sets of trirectangular axes, each of which sets is converted into itself by a tetrahedral group contained as subgroup in the icosahedral group. There are no subgroups of orders 15, 20, or 30 present.

Isomorphism and Transformation.—Groups which have the same algebra are called isomorphic. Written in the same symbols, isomorphic groups are by definition identical. But in the practice the isomorphism requires to be detected, being veiled under dissimilarity of notation. Once detected among groups derived perhaps from quite different mathematical fields, isomorphism constitutes the unifying principle already mentioned. For example, the tetrahedral group is isomorphic with the group of 12 substitutions (rearrangements) which it produces among the four vertices of the tetrahedron; and the icosahedron group is isomorphic with the corresponding group of substitutions of the five trirectangular axis systems mentioned above. These isomorphisms contribute materially to the theory of equations of degrees four and five.

One instance of isomorphism is expressible by a universal formula. Let G be any group, with elements $a, b, c, \ldots$, and let t be any element whatever capable of combination with $a, b, c, \ldots$, under conditions (1)—(3); then the elements $a' = t^{-1}at$, $b' = t^{-1}bt$, $c' = t^{-1}ct, \ldots$ form a group $G'(t^{-1}Gt)$, and this group G' is isomorphic with G. For if $ab = c$, for example, then $a'b' = t^{-1}at \cdot t^{-1}bt = t^{-1}abt = t^{-1}ct = c'$, so that not only a', b', c' form a group, but the algebra of this group is identical with that of G. The process of deriving G' from G is called *transformation* of G by t; G' is called the *transform* of G by t. All transforms of a group G (by $t, s, \ldots$) are isomorphic with G and with each other.

Transformation has a very simple concrete significance. Suppose that G is a group of *operations*, $a, b, c, \ldots$ performed on a field of objects A, and that t converts A into a second field of objects B; then $t^{-1}Gt$, *i. e.*, t reversed, followed by G, followed by t, produces among the objects B an effect precisely parallel to that produced by G on the corresponding objects A. For example, if A is a plane, G a group of operations in A, t a projection of A on a second plane B, then $t^{-1}Gt$ is the projection of the group G on B. Or again, if G is a group of rotations about an axis A, and t a rotation which moves A into the position B, then $t^{-1}Gt$ is a second group of rotations, precisely similar to G, performed about the new axis B. In general, transformation in the present sense is the concomitant, for operations, of transformations in the ordinary sense as affecting objects.

Group Analysis.—If G is any group and H any subgroup of G, all the transforms of H with respect to the elements of G are contained in G. These transforms are called the conjugates of H in G. Thus the subgroups of order 3 of the tetrahedral group are conjugate in that group. A noteworthy general example is that of the subgroups of order p^a (a a maximum) of a group G; these $kp + 1$ subgroups are always conjugate. The number of conjugates of any subgroup H of G is a divisor of g. In the important case where its conjugates all coincide, H is an *invariant* subgroup of G. Every group G has two invariant subgroups, itself and the identical operation. If it has no other invariant subgroups, G is *simple;* otherwise G is *compound.* Thus the four rotations $1, b_1, b_2, b_3$ of the tetrahedral group form an invariant subgroup, this being in fact the only subgroup of order 4, of the tetrahedral group.

A *maximum* invariant subgroup H of G is not contained in any larger invariant subgroup

of G. A *principal series of composition* of G consists of G and a series of subgroups, H, I, J, ..., 1 of G, each of which is a maximum invariant subgroup of the preceding one. The ratios of the orders g, h, i, j, ..., 1 of these subgroups is a principal series of *factors of composition* of G. Apart from their order of succession, these factors of composition remain the same for every principal series of composition of G. They play an important part in the theory of algebraic equations.

Every compound group G is reducible to a sequence of simple groups, whose orders are the factors of composition of G. Only simple groups present new problems. The chief problem of the pure theory of groups is therefore the determination of all simple groups. This problem awaits solution. All groups of prime order are simple. Simple groups of composite order are of rare occurrence, the only cases below order 2000 being one group for each of the orders 60, 168, 360, 504, 660, 1092. The number of different prime factors in the order of a simple group not of prime order is at least three, and the total number of prime factors is at least six (orders 60, 168, 660, 1092 being the only exceptions). No simple groups of odd order have as yet been found. Several series of orders of simple groups are known, for example, $\frac{1}{2}n!(n \neq 4)$, $\frac{1}{2}p^n(p^{2n}-1)$, $(p^n > 3)$, etc.

A group whose elements are commutative is called an *abelian* group. Every subgroup and every element of an abelian group is invariant. The factors of composition are here the prime factors of the order.

Example of Group Construction.—Let a and b be two elements of prime orders p and q $(a^p = 1 = b^q)$ and subject to the further condition $b^{-1}ab = a^i$. We find successively $b^{-1}a^2b = b^{-1}ab \cdot b^{-1}ab = a^i \cdot a^i = a^{2i}$, $b^{-1}a^3b = a^{3i}$ .... $b^{-1}a^jb = a^{ji}$; $b^{-2}a^jb^2 = b^{-1}(b^{-1}a^jb)b = b^{-1}a^{ji}b = a^{ji^2}$, $b^{-3}a^jb^3 = a^{ji^3}$, ..., $b^{-k}a^jb^k = a^{ji^k}$, ..., $b^{-q}a^jb^q (= 1a^j1) = a^j = a^{ji^q}$, ... $i^q \equiv 1 \pmod{p}$. If $p-1$ is not divisible by q, i must be 1, $b^{-1}ab = a$, $ab = ba$, that is, a and b are commutative, and their various products ab form an abelian group of order pq. (This group consists of the powers of one element, say ab.) But if q divides $p-1$, the congruence $i^q \equiv 1$ has roots i different from 1. Any one of these roots i having been chosen, the conditions $a^p = 1 = b^q$, $b^{-1}ab = a^i$ are consistent and lead again to a group of order pq composed of the distinct products a^kb^l; the last group is non-abelian. For $p = 3$, $q = 2$, the second group presents the *multiplication table*

1	1	a	a^2	b	ab	a^2b
a	a	a^2	1	ab	a^2b	b
a^2	a^2	1	a	a^2b	b	ab
b	b	a^2b	ab	1	a^2	a
ab	ab	b	a^2b	a	1	a^2
a^2b	a^2b	ab	b	a^2	a	1

Substitution Groups.—The permutations or *substitutions* of n given letters x_1, x_2, ..., x_n form a group (the symmetric group) of order $n!$. The order of any group of substitutions of n letters is a divisor of $n!$. An individual substitution is written in cycles: thus $(x_1 x_2 x_3)(x_4 x_5 x_6 x_7)$, or simply $(1\,2\,3)(4\,5\,6\,7)$, signifies that x_1, x_2, x_3 are to be replaced by x_2, x_3, x_1, and x_4, x_5, x_6, x_7 by x_5, x_6, x_7, x_4. Every finite group is expressible as (isomorphic with) a substitution group. Thus in the case of the group of order 6 above, if we denote the elements $1, a, a^2, b, ab, a^2b$ for convenience by $x_1, x_2, \ldots, x_6$, the six lines of the table are obtained from the first line by the six substitutions 1, (123)(456), (132)(465), (14)(26)(35), (15)(24)(36), (16)(25)(34), which form a substitution group isomorphic with the original group.

Those substitutions of n letters $x_1, x_2, \ldots. x_n$ which leave a given function of $x_1, x_2, \ldots. x_n$ unchanged in form, form a group. Thus the function $\phi_1 \equiv x_1x_2 + x_3x_4$ is unchanged by the eight substitutions G_1 : 1, (12), (34), (12)(34), (13)(24), (14)(23), (1324), (1423). The substitution t : (23) converts ϕ_1 into $\phi_2 \equiv x_1x_3 + x_2x_4$ and *transforms* the group G_1 of ϕ_1 into the group $G_2 = t^{-1}G_1t$: 1, (13), (24), (13)(24), (12)(34), (14)(23), (1234), (1432) of ϕ_2.

Interesting examples of substitution groups may also be obtained by determining those substitutions of n letters $x_1, x_2, \ldots, x_n$ which transform the substitution $(12\ldots.n)$ into its powers. If n is a prime number, the order of this (metacyclic) group is $n(n-1)$.

For further discussion of substitution groups see the article GALOIS THEORY OF EQUATIONS.

Groups of Linear Transformations.—All the linear transformations of a complex variable z, $z' = (\alpha z + \beta) / (\gamma z + \delta)$, for which $\alpha\delta - \beta\gamma \neq 0$, form a group. For two of them in succession evidently amount to a third linear transformation. Thus $S : z' = 1/z$ and $T : z' = 1 - z$ give $ST : z' = 1 - 1/z = (z-1)/z$, $TS : z' = 1/(1-z)$. The group of all linear transformations of z is both infinite and *continuous*. If $\alpha, \beta, \gamma, \delta$ are restricted to integral values, the resulting group is still infinite but discontinuous. The *modular* group is subject to the still further condition $\alpha\delta - \beta\gamma = 1$; this is the group connecting the values of the ratio ω of the two periods ω_1, ω_2 of the elliptic integral $u = \int (4z^3 - g_2z - g_3)^{-\frac{1}{2}}dz$.

There exist only a finite number of non-isomorphic types of finite groups of linear transformations of z. If z is represented on a spherical surface, every rotation of the sphere produces a linear transformation of z. Those rotations of the sphere which convert into itself a regular solid inscribed in the sphere, or a regular polygon of n sides inscribed in a great circle (equator), form a group. These groups are of orders 60 (icosahedron, dodecahedron), 24 (octahedron, cube), 12 (tetrahedron), $2n$ (dihedron), n (cyclical). They give all the non-isomorphic types of finite groups of linear transformations of z. The octahedral group is also isomorphic with the symmetric substitution group of four letters, the tetrahedral and icosahedral groups with (alternating) substitution groups of four and five letters, respectively.

A simple example of a (dihedral) group of order 6 is generated by the transformations $S : z' = 1/z$ and $T : z' = 1 - z$ above.

The linear transformations of z written in homogeneous form $z'_1 = \alpha z_1 + \beta z_2$, $z'_2 = \gamma z_1 + \delta z_2$ furnish *homogeneous* linear groups. Increasing the number of variables, we arrive at the general homogeneous linear groups $z_1{}^{1'} = a_{11} z_1 + a_{12} z_2 + \ldots. + a_n z_n$, $z_2{}^{1'} = a_{21} z_1 + a_{22} z_2 + \ldots. + a_{2n} z_n$, ... $z_n{}^{1'} = a_{n1}z_1 + a_{n2}z_2 + \ldots. + a_{nn}z_n$ identified, for example, with projective geometry. Curves, surfaces, etc., frequently

have linear transformations into themselves, these always forming a group. Thus a plane cubic curve has in general such a group of order 432. Linear *congruence* groups should also be mentioned. An example is the *simple* group of order $\frac{1}{2}p(p^2-1)$ $(p>4)$ composed of the linear transformation $z' = (\alpha z+\beta) / (\gamma z+\delta)$ when $\alpha, \beta, \gamma, \delta, z', z$ are integers taken mod. p

Continuous Groups.—These are groups of transformations involving continuous parameters, such as the entire group of linear transformations of z, or the entire group of motions in a plane or in space. The theory of these groups, which has been extensively developed by Sophus Lie and his followers since 1870, has important applications to geometry, and especially to the theory of differential equations.

Historical.—The theory of groups was originally developed by Galois, Cauchy, and their successors under the particular guise of substitution groups. It was with Sylow's memoir in the 'Mathematische Annalen,' Vol. V. (1872) that the theory began to assume its independent abstract form. Among those who contributed to this movement are Cayley, Klein, Dyck, and others. But it is to Frobenius, above all others, that we owe the great developments of the pure theory which have been accomplished in the last fifteen years. The theory of group *characteristics*, recently created by Frobenius, is destined to produce brilliant results in the near future.

Other historical elements are traceable in the accompanying bibliography.

Bibliography.—Burnside, 'Theory of Groups' (1897); Cayley, 'American Journal of Mathematics' (1878); Dickson, 'Linear Groups' (1901), 'Theory of Equations' (1903); Easton, 'Constructive Development of Group Theory, with a Bibliography' (1902); Frobenius, 'Sitzungsberichte' of the Berlin Academy (1895 *et seq.*); Jordan, 'Traité des substitutions' (1871); Klein, 'Ikosaeder' (1884); Netto, 'Substitutionentheorie' (1882); Serret, 'Algèbre supérieure' (1866); Sylow, 'Mathematische Annalen' (1872); Weber, 'Algebra' (1899).

Frank Nelson Cole,
Professor of Mathematics, Columbia University.

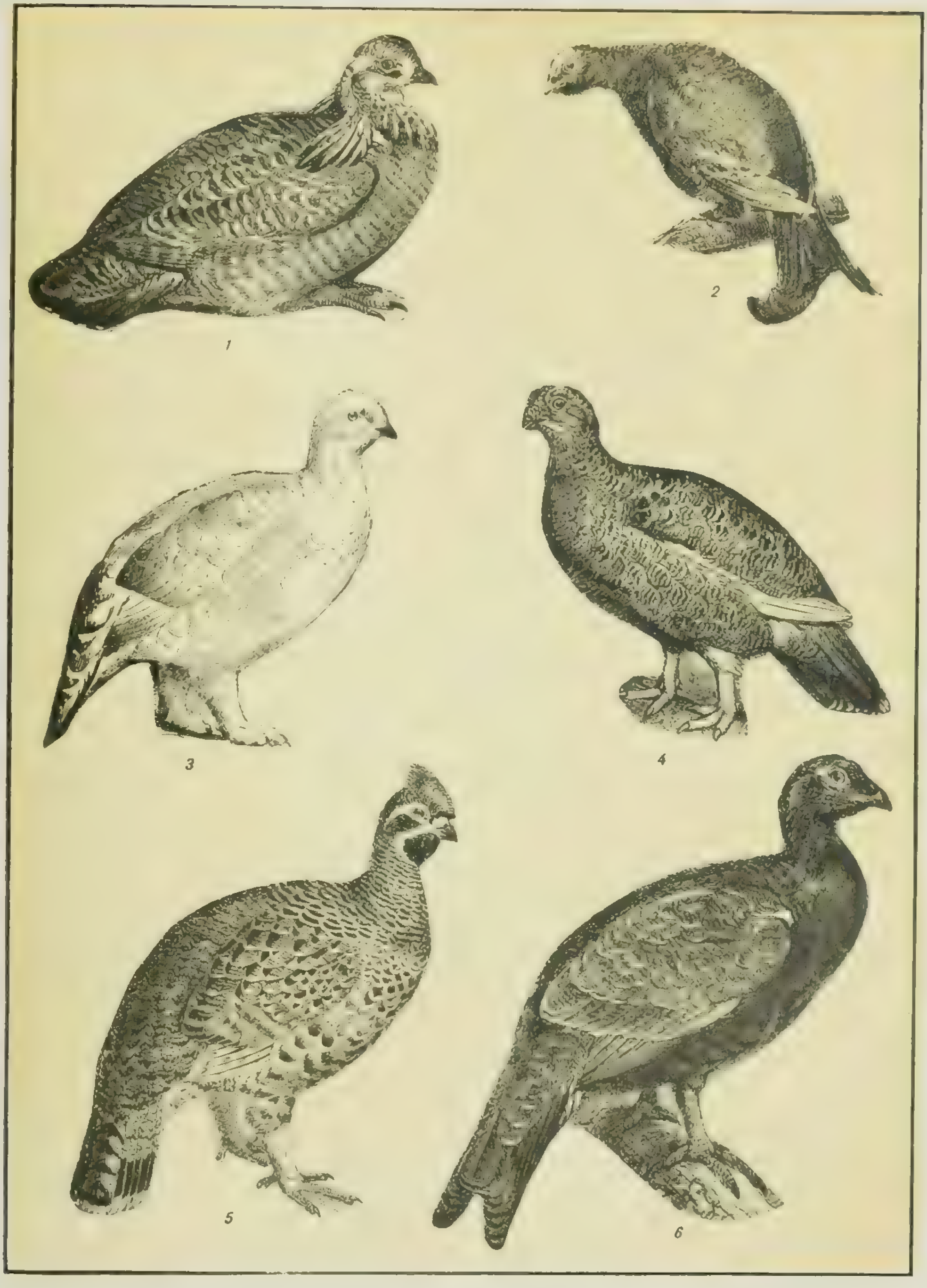
Grouse, a family (*Tetraonidæ*) of gallinaceous game birds with feathered feet or tarsi, inhabitants of the northern hemisphere. In North America our best known species is the ruffed grouse (*Bonasa umbellus*); the "partridge" of New England and the "pheasant" of the Middle States. This bird, in one or other of its races, ranges all across the continent from Canada to Washington and southward in the higher ground, and is one of our best esteemed game birds. The rumbling drumming of the male is a familiar sound in the woods in early spring, and is effected by rapidly beating the wings against the body. On the prairies of the central and western States are several varieties of pinnated grouse or prairie chickens (q.v.). In the northwest occur the blue or dusky grouse (*Dendragapus fuliginosus*) and the sage hen (q.v.). In Canada and the northernmost part of the United States occurs the Canada grouse or "spruce partridge" (*Canachites canadensis*) with the allied Franklin's grouse (*C. franklini*) in the northern Rocky Mountains. The species to which the name grouse was originally applied, namely the red grouse or moorfowl (*Lagopus scoticus*) of England, is the only bird absolutely restricted to the British Isles. It is plentiful in suitable parts of Wales and northern England, but is especially numerous in the highlands of Scotland, where it is bred and preserved on moorlands of great extent, large areas of which are kept barren of other occupation for this purpose. This, then, is the bird whose shooting, permitted for a period following the 12th of August, attracts so large numbers of sportsmen annually to Scotland for the "grouse-shooting." The sport may be followed in the ordinary method of shooting on the wing over dogs; but in many places is conducted as a battue. Grouse-moors are owned and rented in large numbers, and have a status similar to that of deer-forests (q.v.). This grouse is a ptarmigan, other species of which exist in the artic regions (see Ptarmigan). Other European grouse of importance are the blackcock and capercailzie (q.v.). Among works dealing especially with grouse and grouse-shooting are Lloyd, 'Game Birds and Wildfowl of Sweden and Norway' (London, 1867); the volumes on 'Shooting' in the 'Badminton Library' (London, 1889); Alflalo, 'Sport in Europe' (London, 1901); Sandys and Van Dyke, 'Upland Game Birds' in the Sportsman's Library (New York, 1902); Coues, 'Birds of the Northwest' (Washington, 1874).

Grove, Sir **George,** English engineer, author, and musical critic: b. Clapham, near London, 13 Aug. 1820; d. Sydenham 28 May 1900. After completing his studies in the grammar schools of Clapham, he learned civil engineering, and for two years worked in Napier's factory near Glasgow. In 1841 he went to the West Indies, erecting in that year the Morant Point lighthouse in Jamaica, and in 1845 the Gibb's Hill light in Bermuda. He was appointed secretary to the Society of Arts in 1849, and in 1852 to the Crystal Palace. While in the latter position he exerted all his influence toward giving the music-loving public the best music obtainable, and endeavoring especially to create a taste for the compositions of Beethoven and of the German Romantic School. From 1868–83 he was editor of 'Macmillan's Magazine,' and from 1878–89 edited the famous 'Dictionary of Music and Musicians.' In 1882 he was made the first director of the Royal College of Music, at the same time being knighted, and in 1894 was made a Commander of the Bath. He contributed to Smith's 'Dictionary of the Bible' (1864), and to Stanley's 'Sinai and Palestine' (1865).

Grove, Sir **William Robert,** English physicist; b. Swansea, 1811; d. 1896. He was graduated at Oxford in 1832, began the practice of law in 1835, but eventually applied himself to the study of physics. He was elected professor of experimental philosophy to the London Institution, 1840–47, and received the Royal medal from the Royal Society for his paper on the 'Gas Voltaic Battery.' Returning to the law he was knighted and made a judge of the High Court of Justice. He was one of the first to grasp the law of the "conservation of force." He is the author of 'The Correlation of Physical Forces' (1846).

Grove City, Pa., borough in Mercer County, on the Pittsburg, B. & L. E. railroad; 58 miles north of Pittsburg. It is the seat of the Grove City College, a coeducational school opened in 1884. The chief manufactures are

GROUSE.



1. Prairie Hen (Tympanuchus Americanus).
2. Blackcock (Tetrao urogallus).
3. Moor-hen or Ptarmigan (Lagopus albus) in winter dress.
4. Scotch Red Grouse (Lagopus scoticus).
5. Ruffed Grouse (Bonasa umbellus).
6. Hybrid between Blackcock and Capercailzie.

carriages, brooms, gas-engines, and machinery. Pop. 1,615.

Grover, Cuvier, American army officer; b. Bethel, Me., 24 July 1829; d. Atlantic City, N. J., 6 June 1885. He was graduated at the United States Military Academy in the class of 1850, and on the outbreak of the Civil War was appointed captain of the 10th infantry. Returning East, in April 1862, brigadier-general of volunteers, was assigned to duty with the Army of the Potomac, with which he participated in the various battles of the Peninsular campaign in Virginia, and in the second battle of Bull Run. In 1864 he commanded the 19th corps, and in the Shenandoah campaign was engaged in the battles of Opequan, Fisher's Hill, and Cedar Creek. He was mustered out of the volunteer service in 1865, and in 1875 became colonel of the 1st cavalry.

Grover, Lafayette, American politician: b. Bethel, Me., 29 Nov. 1823. He was admitted to the bar in Philadelphia in 1850, and settled in Salem, Ore., in 1851, where he became prominent in his profession, and was made prosecuting attorney of the second judicial district, and auditor of public accounts. In 1853 he was elected to the territorial legislature, serving there three years, and being speaker in his last term (1856). He fought in the Indian wars in 1853 and 1855–6, and was later made United States commissioner to audit spoliation claims. In 1857 he was a member of the Oregon constitutional convention, and when Oregon was admitted as a State, he was member of Congress (1858–9). He was chairman of the Democratic State committee (1866–70); served as governor of the State 1870–7; and was United States senator 1877–83.

Groves. See ASHERA.

Groveton, Va., Battle of. See BULL RUN, SECOND BATTLE OF.

Grow, Galusha Aaron, American statesman: b. Ashford (now Eastford), Windham County, Conn., 31 Aug. 1823. He was graduated from Amherst College in 1844, was admitted to the bar of Susquehanna County, Pa., in 1847, was elected to Congress in 1850, and was six times re-elected, once unanimously, from the same district. During his first three terms he was a Free-Soil Democrat, during the last three a Republican. He was chairman of the committee on the Territories in the Thirty-fourth and Thirty-sixth Congresses, and speaker of the Thirty-seventh Congress, whose five-weeks' session of 4 July — Aug. 6 1861 largely defined the government attitude toward the Confederacy and voted $500,000,000 for war purposes. He introduced the Homestead bill (see HOMESTEAD LAWS) into the House, fought for it 10 years, finally obtained its enactment, and signed it as speaker. In 1879 he declined the mission to Russia, in 1894 was elected from Pennsylvania as congressman-at-large, and was successively re-elected to the Fifty-fourth, Fifty-fifth, Fifty-sixth and Fifty-seventh Congresses. His plurality in 1896 was 297,446, the largest ever given in any State of the United States to a candidate for any office. He was also a delegate to the national Republican conventions of 1864, 1884, and 1892, and chairman of the Pennsylvania State Republican committee in 1868. In 1871–6 he was the president of the International and Great Northern railway company of Texas. His long record of conspicuous service is almost unparalleled in the political annals of the United States.

Growth, increase in size or volume. It may be divided into inorganic and organic growth. As an example of the former is the increase in size of minerals. Living beings or organisms grow by adding to the substances (protoplasm, etc.) forming their bodies similar matters as food, which are digested, assimilated, and thus taken into the body of the plant or animal by interstitial deposit. Organic growth is thus fundamentally a physico-chemical process together with a form of constructive energy as yet quite incomprehensible to us. The result of this absorption of food is that the body increases in size, that is, grows. All growth is attended by movement; and growth-movements are, as Verworn states, common to all living bodies, but they take place so slowly that they can scarcely be followed with the eye. Growth goes on more freely and the size of the body increases most rapidly in those organisms in which the body presents a large raying surface, in distinction from the microscopic bodies of the one-celled plants or animals. The simplest phenomenon of growth is seen in cells, which during growth rapidly multiply by self-division, which causes the increase in volume in the embryo.

The physical agents or factors in the growth of plants and animals are abundance of food, together with the influences exerted by heat, light, etc. During growth the simple molecule of living proteid continually attracts elements to itself from the food (Hatschek). Growth is most rapid in a well-fed plant or animal. The health, size, and stature of children depend on good nutritious plain food and plenty of fresh air.

Food and Chemical Agents.— As digestion and assimilation are chemical processes, they require certain materials to work with. These are called food. The elements which constitute food and which occur in protoplasm and flesh are carbon, oxygen, nitrogen, lime, phosphorus, potassium, sodium, chlorine, magnesium, sulphur, silicon and iron. All or any of these enter the body in various combinations, each playing a definite part in growth. Phosphorus is especially abundant in the tissues of embryos; potassium appears to be of great importance in imbibition, while iron is essential in the early processes of cell-division. Besides these inorganic substances, organic food, as flesh or vegetables, are essential to the growth of animals. Water is also essential, and embryos develop most rapidly in moist places or in water.

Light.— Without light there would be no growth, indeed no life. Light may retard or hasten growth, under different circumstances. Young growing plants and embryos of animals need to be protected from too direct sunlight.

Temperature.— Organisms need sufficient heat in order to grow. The requisite amount for normal, maximum growth is called the optimum temperature, for at such a degree of warmth growth takes place faster than at any other. If the temperature be lowered, the rate of growth gradually diminishes; if the temperature be raised too much above the optimum, the rate of growth diminishes more rapidly. Excess of cold dwarfs both plants and animals.

Space and Movement.— If too much crowded, plants become slender and weak; snails become dwarfed if reared in too small vessels; mankind when confined to too narrow quarters in large cities tend to become undersized, from not having sufficient space and good air to live in; small trout live in small brooks and large ones in larger streams. All organisms need room to move or at least to grow.

Heredity.— Besides the factors already mentioned heredity has its share as an agent. Growth, development and reproduction are now in the plant and animal world proceeding as it were in grooves, or along more or less definite paths, in accordance with long established laws or relations, and the mechanism of growth is subject to heredity.

Growth and Longevity.— The elephant and whale attain a colossal size because they grow throughout life and live long. The large size of man as compared with many other mammals, is due to the fact that he grows for a longer period; while many mammals get their growth in one, two or three years, man does not stop growing until he is thirty.

It is to be observed that individual growth is not only dependent upon a suitable amount of food, but on proper environment and favorable conditions of life, and all these agencies also are the primary factors of organic life. It is the changes in the conditions of life, coupled with heredity and selection, that have caused the evolution of the world of plants and animals. Thus we see that the fundamental causes of the evolution of species are the same as those which determine the growth of any individual organism; we by no means understand all the phenomena of simple growth; there are unexplained laws and causes, as there are in general evolution; both in this respect are of a piece and are similar in their nature and results. The origin of species is as natural a process as the growth of the individual, and both in many respects are alike inexplicable by the science of the present day.

Growth and Development of the Human Being. In this article growth refers to an increase in size, and development to an increase in capacity. The body begins in a microscopic cell, and passes through the various stages of birth, growth, development, decline, and death.

The life of an individual may be studied in various periods, the embryonic and fœtal (which do not concern us at this time) and those of infancy, childhood, youth, maturity, and old age. The above division is convenient, but not physiologically exact. The various periods are not sharply limited. From birth to maturity, with a gradual increase in size of various organs, there are progressive modifications of functions. Toward old age, decline begins and the modifications retrogress.

The Period of Infancy is variously limited by different writers, extending from birth to the end of the fourth, fifth, or even the seventh year, the last considered by law as the beginning of responsible life. Probably the best limitation is from birth to the end of the first dentition, about the end of the second year. At birth, connection with the mother suddenly ceases, and a new existence begins with the first inspiration. Then the vegetative functions, digestion, circulation, respiration, secretion, excretion, and assimilation, are soon established. The infant performs all the functions of adult life except reproduction and volition. But in order to have them at their best they should be intelligently supervised by the parents. The young baby is the most helpless and dependent of all creatures. The care it receives influences its future life. With no care it must perish.

The period of infancy is characterized by frailty, active nutrition, rapid growth, and commencing development. It is especially prone to convulsions from improper food, or from high body temperature, whatever the cause, to rickets and scurvy from improper nourishment, to spasmodic affections such as false croup, to hydrocephalus, meningitis, whooping cough, diphtheria, diarrhœa, bronchitis, pneumonia, and to the eruptive diseases, measles, chicken-pox and scarlet fever.

The rate of infantile mortality is very high. From one fourth to one half of the children born in our large cities die within the first year; in small towns and in the country the rate is much lower. Many of the new-born are enfeebled by vices of formation, such as cyanosis, spina bifida, hydrocephalus, or meningocele, by an hereditary syphilitic, scrofulous, or tuberculous taint, or by chronic affections in the mother. All infants are exposed to the risks of an improper dietary, impure air, and the extremes of heat and cold.

The bones of the infant are very vascular, quite elastic, have but little firmness, and their epiphyses are cartilaginous. They are therefore readily inflamed, as in scurvy, may be distorted by pressure, or incompletely broken by apparently slight injuries, or the epiphyses may be separated by such injuries. To forcibly lift a young child by one arm is always dangerous. The skull at birth is not fully ossified and can be readily compressed. The anterior fontanelle begins to close about the 9th month and is usually closed about the 18th. Depression of this fontanelle is one of the evidences of general debility. Premature closure of the skull is a cause of epilepsy or idiotism. The vertebral column is straight, lacking the curves of later life, and is quite flexible, but this flexibility tends to backward, forward, or lateral distortions of the spine, as the result of rickets, inflammation (caries) of the vertebræ, or of sitting, standing, or reclining in strained positions. Allowing infants (especially feeble ones) to sit, stand, or walk too early tends to produce bow legs and knock knees, as well as spinal deformities. It is many weeks before a baby can hold up its head. Even by the twelfth week it is not properly balanced. It may be at the sixteenth. The first attempt to sit is about the sixteenth week, and sitting is accomplished about the fortieth. About the thirty-eighth week, the child attempts to stand, and should be able to stand alone by the eleventh or twelfth month, and to walk unaided by the fifteenth or seventeenth month. Some children never creep. If they do, the attempt is made about the ninth month.

The muscles of an infant are soft and not capable of great effort. Not till after the sixth month are they felt firm and resisting. To develop them the clothing should be loose, and the child, in a nude state, should at times be allowed free play of them. To swathe the feet and limbs in bandages «to make the child straight» is hurtful.

The abdomen and chest (in its lower portion) are prominent, due to the very large liver, the small pelvis, and the distention of the stomach by food, and to large size of the heart and lungs. All of these organs must have free movement, in order to carry on their important functions. Tight bandaging of chest or abdomen hampers movement and compresses important blood vessels. The size and weight of the heart of the new-born explains the rapid growth of the body and those organs in most direct communication with the heart, especially the brain. The small size and the vertical position of the stomach account for the ease with which infants throw up their food when the stomach is distended. Repeated acts of vomiting are injurious. The practice of jolting babies tends to produce vomiting. Each child must be studied by itself as to its powers of digestion, and what is the proper food for each. The substitution of artificial feeding for maternal nursing, and the indiscriminate use of baby foods are responsible for much sickness and many deaths. But natural feeding is not always possible, owing to the dictates of fashion or the poor health of mother or child.

The nervous system of infants is very excitable, especially toward the end of the first year, and is out of proportion with the slow development of the inhibitory centres. Convulsions and spasmodic affections are therefore readily produced by various causes, such as undigested food, eruptive fevers, impure air, fright, or excessive heat. Most of the movements and actions of early infancy are reflex, such as stretching, crowing, and sighing, for example, About the fourth month evidences of will power appear and gradually increase. Good habits, as to regular times for feeding, sleep, etc., can often be inculcated at this early age, or even before, to the advantage of both mother and child. The brain is relatively large at birth and grows rapidly up to the seventh year, and after that time more slowly.

During this formative period care should be observed not to excite the brain unduly, else nervous disorders may result. Repeatedly urging a young child to "show off" is, to say the least, very unwise.

The senses of taste and smell seem to be partially developed at birth. After the third month the quick closure of the eyes on the approach of an object seems to indicate the establishment of true vision. A very bright light may be appreciated by the second or third day, or may be followed by the eyes, if moved slowly, after the sixth week. It is usually weeks before there are associated movements and convergence of the eyes. The eyes of the new-born frequently move independently of each other, producing "squint," but squinting in the course of a severe disease is a bad sign. As to colors, yellow, red, pure white, gray, and black, in the order named, are said to be the first recognized, gradually after the sixth month.

All children are born deaf, but may notice sharp sounds six hours after birth, though usually not until a number of days. Toward the end of the first year the infant begins to imitate vocal sounds in its attempt to speak.

The circulation of blood is very rapid; the blood vessels are large and thin. Congestions, inflammations, and hemorrhages, therefore, are quite common. The pulse is irritable and slight causes disturb its rate and sometimes its regularity. The rate in the new-born is 130–140, during the first year 105–150 per minute, during the second 110–120, then gradually diminishes until at the fifth year it is about 90; from the seventh to the fourteenth year 80–90, and afterward 70–80. The respirations of the new-born are from 30 to 50 per minute, and at the end of the first year from 25 to 35. The breathing of healthy children is noiseless and through the nose. The habit of mouth breathing usually caused by enlarged tonsils and by adenoid growths, is productive of deafness, change in facial expression and distortion of the chest (pigeon breast). The relatively small size of the pharynx, larynx, and trachea frequently cause throat affections to be serious ailments in infants.

The average temperature of the infant is 100° F., but it is subject to many fluctuations. It is raised by ingestion of food, struggling, crying, etc., and lowered by sleep, inactivity, and insufficient food. Sponging with cool water or oiling the skin will frequently lower a high body temperature, which, if unchecked, might cause convulsions.

In man there are two sets of teeth. The first or temporary teeth are 20 in number, 10 in each jaw. The first tooth appears about the seventh month, the last about the twenty-fourth month. The dangers of dentition are much exaggerated. Well-nourished children of healthy parents cut their teeth earlier, easier, and more regularly than do feeble children. If the first tooth is not cut before the 14th month there is some serious defect. About the 6th year (and before the temporary teeth are shed) the jaws contain all the temporary teeth and all the rudimentary permanent teeth except the wisdom teeth. At birth, when the teeth have not appeared and in old age when they have disappeared the lower jaw is obtuse. During the growth of the teeth, the lower jaw increases in depth and length. To admit of these changes, the temporary as well as the permanent teeth should be taken care of, and filled if need be. Food requiring mastication should not be given until there are several teeth. The permanent teeth are 32 in number, 16 in each jaw. The first one appears about the 6th year, the last from the 18th to the 24th or later. The thymus gland appears in the new-born, attains its full size by the end of the 2d year, then gradually diminishes until at puberty it has almost disappeared. It is supposed to be one of the sources of the red blood corpuscles.

For the first few months of life tears and perspiration are rare. After three months they are freer. In rachitic infants perspiration is often profuse. Up to the end of the first year the sebaceous glands are very active, especially upon the scalp. The saliva and pancreatic juice are small in amount until about the third month and therefore starchy foods cannot safely be given to young infants. The gastric secretion at birth can as a rule readily digest the casein of mother's milk, but has difficulty in disposing of other food. Mucus in the infantile intestines is copious, often ferments and may neutralize the feebly alkaline intestinal juices, and the pancreatic juice and saliva.

Both the small and large intestine are com-

paratively long, and digestion and peristaltic action are rapid. These facts together with the small size of the stomach and the rapid growth of the body, require that the young baby be fed every 2 or 3 hours. The great length of the sigmoid flexure of the colon impedes the passage of fæces and induces constipation, which should be relieved by *light* laxative medicines or, better still, by change in the diet.

The lymphatic glands are numerous and large in the infant and the communication between them and the general system is more marked than at any other period of life. They are readily congested and enlarged in affections of the throat, scalp, etc., and in scrofulous and syphilitic ailments.

The average weight of the male new-born child is 7 lbs. 11 oz.; of the female 7 lbs. 4 oz. For the first few days there is a loss in weight, then the weight gradually increases. Generally it is doubled by the 5th month and trebled by the 12th in breast-fed infants; in hand-fed, later. Usually a healthy child gains 20 lbs. in weight and 10 inches in height in first 2 years of life; in the 3rd year 4 lbs. and 4 inches. During next 6 years there is an annual increase of 4 lbs. and 2 or 3 inches; after the 10th year about 8 lbs. a year. About the 9th year in girls and the 11th in boys there is a diminution in the rate of growth, and at puberty (13th year in girls and 16th in boys) the activity of growth is the greatest. Between 12 and 15, girls grow heavier and taller than boys, but at 15 the boys again lead and maintain it through life. Growth usually continues to about the age of 25 in males and there may be a slight increase for 5 or 10 years afterwards. Girls usually attain adult stature at about 21 years. Weight usually increases in the male and frequently in the female to the 50th or 60th year, due to an accumulation of fat.

The Period of Childhood may be said to extend from the end of the second year to puberty or youth. By the end of infancy, the anterior fontanelle is closed, the temporary teeth are cut and the child is beginning to talk and walk, to use judgment and memory and to display independence. Childhood is characterized by active growth and development of the body and mind. Arrest of growth and loss of weight indicate malnutrition. On the other hand, while a very thin baby is abnormal, a very fat child or youth is, as a rule, one whose nutrition is at fault, or whose diet is too rich or generous.

The preparation of boys and girls for the duties and responsibilities of manhood and womanhood, requires especially that their brains, muscles, and digestive apparatus shall be strong. Nerve force must be stored not dissipated, and coddling is wrong. Their nervous systems are normally very active and sensitive to impressions, hence nervous disorders and exhaustion are readily induced by over-stimulation of the brain, through excitement, too much study, etc. Physical and mental training must go together. A vigorous child is almost constantly in motion, either at work or play, and this is as it should be. The same amount of exercise would exhaust an adult. It is well understood that systematic muscular exercise besides hardening the muscles improves the mental strength, that well developed children take a higher rank in school than those of the same age less developed. Abundant out of door exercise also develops the co-ordinating power of muscles and the special senses, induces a greater respiratory range, better oxidation, and an increased power of the heart. Thus nutrition is stimulated and a symmetrical development obtained. And this is just as necessary for girls as for boys. Children need sleep oftener and longer than adults. A healthy young baby sleeps nearly two thirds of the time and a healthy child of seven will often sleep quietly for twelve hours or more. Disturbed sleep and sleeping with the mouth open indicate some nervous gastric or intestinal disturbance or the presence of enlarged tonsils.

After the first few years of life the special senses seem to acquire an acuteness, more marked than in later life when the perceptions are associated with more complex mental processes. Children require much food and the diet should be nutritious, but overloading the stomach, especially with sweets and fruit, may excite general convulsions, vomiting, diarrhœa and alarming fever. A vigorous, healthy boy often eats, and may require about as much food as the average man. A variable appetite or the habit of eating mainly one class of foods is indicative of innutrition. A properly mixed diet is necessary for health. Sugar (candy, etc.), valuable in reasonable amount, should not be eaten in such quantity as to interfere with the appetite for regular meals. Children, especially those who eat but little sugar, should be taught to eat fat. In childhood the lymphatic system is still active, the glands readily enlarge as the result of irritation or of general disease, especially scrofula. The respiration in early childhood as in infancy is mainly diaphragmatic — the abdomen moves freely. The temperature normally is about 100° F. A sudden high temperature is much less significant than in the adult, so also is an increase in the rapidity of the pulse. Young children lose heat readily from the surface of the body, and are susceptible therefore to "taking cold" when insufficiently clad. The line should be carefully drawn between overdressing and the "hardening" process, and woolen garments except in the hottest weather are advisable.

Owing to the large amount of food consumed and the detritus resulting from the activities of the body — a free discharge of waste by the skin, kidneys and bowels should be facilitated by frequent bathing, the drinking of considerable pure water and the use of fruit, graham bread and green vegetables.

The stomach in children is straighter and more vertical than in adults, but less so than in infants. Vomiting is still easily produced. The small intestine is relatively much longer than in adults, due to the fact that much nourishment is to be digested.

Children are susceptible to nervous disorders such as chorea and certain forms of paralysis, and to whooping cough, mumps, measles, etc., which last are often classed as "children's diseases." Spinal deformities are readily induced. Certain diseases, such as tuberculosis, are likely to affect a large number of organs at the same time. The recuperative power of a normally healthy child is very great, even in severe diseases.

The mortality of young children in general is enormous but decreases with age. It is greatest among those whose hygienic conditions are bad, who suffer from poor or insufficient food, impure air, etc. Diphtheria, scarlatina, measles, croup, pneumonia and intestinal disorders are the chief causes of death.

The Period of Youth, Adolescence or Puberty, is that period of life between childhood and maturity; in law, "that period from 14 in males and 12 in females till 21 years of age." It occurs earlier in hot climates than in cold, is hastened by luxurious living and habits of idleness and is retarded by severe labor, hardship, privation and ill health. It is that period when the individual becomes fitted for reproduction by the development of the sexual organs. The voice is unsettled, due to a rapid general enlargement of the laryngeal cartilages and a lengthening of the vocal cords. Hair appears in the pubic region, in the axillæ and on the face in the male. In the female particularly, fat is rapidly deposited in the subcutaneous cellular tissue of the breast and extremities, adding to the comeliness of the form. The function of menstruation is established, preceded in a varying degree by headache, backache, physical and mental lassitude, palpitation, bleeding from the nose, nervous irritability and hysteria. Sexual maturity is evidenced by awakened sensibilities towards individuals of the opposite sex, of attraction, of repulsion or of timidity and shyness. In youth there is a pronounced development of the limbs, an increase in the size of the chest and a diminution in the size of the head and abdomen. The spine now forms a double curve, and the pelvis widens especially in the female. Mental faculties mature. A girl becomes a woman earlier than the boy a man.

Inasmuch as the rapid nutritive changes are prone to be attended by more or less grave disturbances of the nervous functions, it is essential, in order to have a sound mind in a sound body (that is, health), to carefully regulate physical and still more, mental exertion. The habit of self control must be encouraged, and exaggerated language discouraged. School duties should not be imposed beyond, or even up to the limit of tolerance of the individual, and social functions should not interfere with an abundance of sleep and outdoor exercise, else the result will be a wreck of the nervous system, and prolonged nervous and muscular prostration. Recklessness as to the laws of health are responsible for much of the sickness at this period of life. Purity of thought and action are great safeguards against the temptations which beset growing youth, which if yielded to they impair or destroy both mind and body. Animal impulses are to be subordinated to aspirations of the mind. The continued fevers such as typhoid, severe inflammations, as pneumonia and acute rheumatism, tuberculosis and heart affections, are the principal diseases of youth. Scarlet fever, measles and other eruptive diseases may affect the individual, but not commonly. Alcoholism is a dangerous condition, easily acquired. Neurotic conditions, especially in the female, too frequently occur.

The Period of Maturity begins at about the end of the 21st year, and extends in men to about the 60th, when the power of reproduction wanes, and in women to about 40 or 45, when the menopause occurs; the breasts and reproductive organs diminish and ovulation ceases. In women, at this time (as in the onset of puberty), the organic functions may be irregular; dyspepsia, palpitation, sweating, vertigo, neuralgia, irritability and melancholy may occur. The "change of life" is in reality therefore attended with a severe nervous shock. Manhood and womanhood begin when the individual has reached the full stature, when the skeleton is firmly ossified, the jaw is square, the chest fully expanded, and the limbs well developed. Gradually from this time onward in most instances fat begins to accumulate, especially upon the abdomen, towards the end of maturity.

Popularly it is believed that man is in the "prime of life" from 35 to 50, but there are many instances of farmers, professional and business men and women being successful and at active work and in good health at 60 or more. The fact is, that the ability to do hard work, mental or physical, at an advanced age, depends upon habits of industry and method, and upon the care of the health which have been inculcated in earlier life, and are continued into and through adult life.

Gradually as adult life advances, the inclination and sometimes the power for active exercise fails. These are evils to be guarded against. Out-door games, horse-back riding, and vigorous walking, for example, may be pursued advantageously as a rule to 45 or 50 years of age. At about this time degenerative changes occur in the body and care is necessary that the heart and blood vessels be not overstrained. During the prime of life the body enjoys a maximum of vigor and power of endurance, and there is reason to believe that this is also true of the mind. But the self-consciousness of power that the individual possesses is frequently a menace, for it induces him to struggle for wealth or fame in the turmoil and bustle of modern life, to neglect recreation, to resort to alcoholics and other stimulants to keep up his energy, and to indulge in general high living. It is especially true at this time of life that no one should work up to the full measure of his ability. Such work is dangerous and has been responsible for the "breaking down" of the health and the death of many otherwise intelligent persons. The principal diseases of adult life are alcoholism, gout, cancer, urinary and venereal diseases, rheumatism, pneumonia, tuberculosis, affections of the brain and nervous system, of the heart and blood vessels and of the digestive system.

The Period of Old Age or Senility usually commences about the 60th year and is characterized by a waning of the vital powers and by atrophic and degenerative changes, the natural consequences of decay. While death frequently results from local accidents of the brain and nervous system (apoplexy, sclerosis, etc.) and of the heart, blood vessels and urinary organs irredeemably damaged in the course of decay, it is normally but the ending of a natural life, and not a pathological fact as in earlier life. The stature of the old is less, the shoulders rounded, bones are more fragile, the cartilages are hardened, the lower jaw resembles that of the infant, the chin is prominent, the skin is wrinkled owing to the absorption of fat, and loses its elasticity, the teeth decay and fall out,

urination is frequently difficult, the respirations and heart beats are reduced in frequency, the arteries have a tendency to ossify, the veins to dilate. The muscles fail in their tension, the voice becomes a "childish treble," the digestion is weakened, the eye no longer sees clearly, and hearing is dulled. The mind may preserve its freshness for a long time. Usually the senses fail first, next the faculties of memory, reason and volition. Towards the close of life the organic or vegetative phenomena prevail. The natural death occurs when the breath becomes fainter and fainter and the heart beats are weaker and fitful — and then gradually cease.

Old people require an abundance of sleep. They need also to be kept warm, for heat is generated in them in smaller amount than in robust health. Hence they are easily chilled. Food should be plain, largely liquid, and that which is easiest digested. Exercise in the open air every day is desirable but it should be gentle in character. With these precautions old age may be made comfortable. JEROME WALKER, M.D.,

Author of 'Walker's Physiology.'

Grub, the larva of an insect, especially of a beetle or fly. In reference to cattle it usually means the maggot of a flesh-fly or warble. See BOT-FLY; LARVA.

Grubb, SIR **Howard**, Irish optician and telescope-maker: b. Dublin 28 July 1844. The largest telescope of his construction is the 27-inch of the Vienna Observatory. He was the first to suggest a movable floor for an observatory dome, which has been adopted in the dome of the great 36-inch telescope of the Lick Observatory. He has been vice-president of the Royal Dublin Society from 1893, and was knighted in 1887.

Grübel, grü'bel, **Johann Konrad**, German poet: b. Nuremberg 3 June 1736; d. Nuremberg 8 March 1809. He was a saddler and harness-maker, and passed his youth in privation; but he possessed genuine poetic gifts, as shown in the pictures he has given of the lives and manners of his countrymen in the three volumes of 'Poems in the Nuremberg Dialect' (1802). Another volume appeared in 1808.

Gruber, grö'ber, **Johann Gottfried**, German author: b. Naumburg, on the Saale, 29 Nov. 1774; d. 7 Aug. 1851. He studied at Leipsic, and in 1811 was appointed professor at the University of Wittenberg, and in 1815 professor of philosophy at Halle. His chief work was that of editing, first with Ersch, and after his death, alone the first section of the 'Universal Encyclopædia.' His independent works include: 'Herder's Characteristic' (1805); 'History of the Human Race' (1805); and Lives of Wieland (1815–16), and Klopstock (1832); he also edited 'Wieland's Complete Works' (1818–28).

Grün'berg, Germany, capital of the circle of Grünberg in the Prussian province of Silesia; on the Oder, 15 miles east of Giessen. It is surrounded by vineyards, and large quantities of wine are made here and in the vicinity. Pop. 21,268.

Grundtvig, groont'vĭg, **Nikolai Frederic Severin**, Danish theologian, historian and poet: b. Udby, island of Seeland, 8 Sept. 1783; d. Copenhagen 2 Sept. 1872. He was educated at the University of Copenhagen, and in 1822 went to Copenhagen as chaplain. He made a fierce attack on the rationalism of the time in his 'The Answer of the Church' (1825), a reply to Professor Clausen, and for the violent expression of opinion in this work was severely censured and resigned his position. For a time he devoted himself to literary work, and through his writings exercised a great influence on the religious and political thought of Denmark. In 1839 he became pastor at the hospital church of Vartov, Copenhagen, and held that position till his death, being made a bishop in 1861. He was for a time a member of the Danish diet, and took an active part against Germany and German influence. His most important work is 'Northern Mythology'; he also wrote a number of poems, among them some very popular national songs, and translated 'Beowulf.'

Grundy, Felix, American jurist: b. Berkeley County, Va., 11 Sept. 1777; d. Nashville, Tenn., 19 Dec. 1840. Studying law, he was admitted to practice in 1798, and soon acquired a high reputation as an advocate in criminal cases. He was a member of the Tennessee legislature 1799–1806, and in the latter year was appointed one of the judges of the supreme court of errors and appeals. In 1811 he was elected representative to Congress, and re-elected in 1813. In 1829, and again in 1833, he was elected to the senate of the United States, where he was among the most prominent of the supporters of President Jackson. In 1838 President Van Buren appointed him attorney-general of the United States; but in 1840 he resigned that office, and was re-elected to the senate.

Grundy, Sydney, English dramatist: b. Manchester 23 March 1848. He was called to the bar in 1869 and practised till 1876, but has since become known at home, and in the United States, as a successful and popular playwright. Among his very numerous plays are: 'The Glass of Fashion' (1883); 'A Fool's Paradise' (1890); 'A White Lie' (1893); 'Sowing the Wind' (1893); and 'The New Woman' (1894); 'Slaves of the Ring' (1894); 'The Degenerates' (1899); 'Frocks and Frills' (1902).

Grundy, Mrs., a personage constantly appealed to in the phrase, 'But what will Mrs. Grundy say?' in Morton's play, 'Speed the Plough' (1800), but who never appears among the *dramatis personæ*. The phrase has now come to stand for the judgment of society in general upon actions or conduct.

Grunt, or **Croaker**, a drumfish (q.v.).

Gruson, groo'sŏn, **Hermann**, German inventor and manufacturer: b. Magdeburg 13 March 1821; d. 1895. He studied at Berlin; became chief engineer of the Wöhlert machine shops in Berlin in 1851, and in 1854 went to Buckau as director of the Hamburg-Mecklenburg steamship company. There he established a shipyard of his own and built a small iron foundry, where he invented a process of chilled cast iron, which was much used in the manufacture of machinery, as well as for armor. His establishment consequently grew rapidly, and in 1886 was incorporated, manufacturing armor for most of the states of Europe. Gruson was manager of the company until July 1891, when he retired and devoted himself mostly to study and experiments in physics. In 1893 the works were sold to Krupp.

Grützner, Eduard, ed'oo-ärd grüts'nĕr, German painter: b. Gross Karlowitz, Schlesien, Germany, 26 May 1846. He began the study of

art without a master, and his talent having been recognized by the architect, Hirschberg, he was taken by the latter to Munich, 1864. He was there admitted to the school of Piloty. Hirschberg engaged him to paint in oil seven pictures for the ceiling of a room in his house, but he first appeared before the public as a humorous painter, Shakespeare's Falstaff being his favorite subject. He is, however, known all over the world for his pictures of monks, in the cellar, tailor's shop, kitchen, etc. Well-known also is his 'Mephistopheles Behind the Scenes in the Dressing Room of a Ballet Dancer.' His drawing is lifelike, his technique masterly, and he possesses a marvelous power of characterization.

Gruyère, grü-yār, or **Gruyères,** Switzerland, a village in the canton of Freiburg, 16 miles south of that city. It is built on a hill crowned by the fine old feudal castle of the counts of Gruyère, and gives its name to the well-known cheese which is made in large quantities in the surrounding pastoral district. Pop. (1900) 1,297.

Gryllidæ, grĭl'ĭ-dē, a family, the crickets, of saltatorial orthopterous insects, distinguished from the grasshoppers and locusts by the fact that the tarsi are three-jointed and the ovipositor, when exserted, is spear-shaped; the wings, when present, fit closely to the body. The family includes three types: (1) the true crickets, such as the common field cricket, or the hearth cricket of Europe, which are of the genus *Gryllus;* (2) the burrowing, curiously modified mole-crickets (q.v.); (3) the tree-crickets, pale-colored nocturnal forms which lay their eggs in the twigs of different plants, and which sometimes are so abundant that by their egg-laying alone they do considerable damage to vineyards and to raspberry and blackberry plantations. The black field-crickets, of which the commonest American species is *Anabrus simplex,* inhabit burrows in the ground and come abroad to feed on grass and herbage at night, and sometimes in daylight. They deposit eggs in the ground in the autumn, but these do not hatch until the following spring. Our black crickets rarely enter houses, but the European hearth-cricket (*G. domesticus*) is naturalized in Canada.

The crickets are the most musical of all this class of insects, and elaborate studies of their song and its variations according to weather have been made by S. H. Scudder. The musical apparatus consists of modifications of the upper edges of the wings, which are more elaborate than those even of the *Locustidæ.* Consult Howard, 'The Insect Book' (1901), which contains a large bibliography.

Gryphon. See GRIFFIN.

Guadalajara, gwä-dä-lä-hä'rä, Mexico, capital of the State of Jalisco. This city, which is one of the finest in the republic, contains a large number of government buildings, schools, and institutions of higher education (including a college of medicine and pharmacy, law school, lyceum, and normal school), a cathedral, several parks, and the largest theatre in the country. The chief industries are the manufacture of cotton goods and leather; there are also two breweries, a paper-mill, and canning factories. Banks are: the Bank of Jalisco, with a capital of 1,500,000 pesos, and branches of the National Bank of Mexico and the London and Mexican Bank. According to the revised census of 1895, the population of the city was 83,934.

Guadalupe (gâ-da-loop') **River,** has its rise in Kerr County, Texas, flows a general east and southeast course into San Antonio Bay. It is about 260 miles long, and is navigable as far as Victoria.

Guadalupe-Hidalgo, gwä-dä-loo'pā-ē-däl'-gō, a village of the federal district of the United States of Mexico, at the foot of the Guadalupe Mountains, three miles north of the city of Mexico. The treaty of peace between the United States and Mexico was signed here 2 Feb. 1848. The village contains the famous picture, 'Our Lady of Guadalupe,' which tradition says was received in a miraculous manner by an Indian, Juan Diego, in 1531. It was long held in high repute by the people in and about Mexico; but it was not until 1757 that Pope Benedict XIV. gave sanction to the devotion.

Guadalupe-Hidalgo, Treaty of, 2 Feb. 1848; the treaty which closed the Mexican War. The place is a suburb of the city of Mexico. While the war was in progress, Polk sent Nicholas P. Trist of Virginia, then chief clerk of the State Department, to negotiate a treaty of peace; the conditions to include the cession of Upper and Lower California and New Mexico (conquered by Kearney, Stockton and Frémont, and a chief object of provoking the war), and the Rio Grande for boundary between Mexico and the United States. Trist went to Scott's headquarters, an armistice was arranged, and in August 1847 the three Mexican commissioners and Trist met and exchanged proposals. The former would not yield to such terms, demanded the Nueces as the boundary (giving them Corpus Christi and a large triangle at the south), and offered much less other territory. Trist was recalled, but remained at headquarters; Santa Anna declared that he was tricked in the proposals, war operations went on, and the city of Mexico was captured not long after. In January 1847 negotiations were resumed, Trist still acting as principal, and the treaty above was agreed on. The Senate, however, refused to accept it, and insisted on harsher terms; Mexico was forced to accept them, and the Senate ratified the treaty 10 March. Formal proclamation was made 4 July 1848. The land cession was of Upper California and New Mexico, and the Rio Grande was made the boundary. The United States paid Mexico $15,000,000, and assumed $3,250,000 of claims made by United States citizens against Mexico prior to the treaty, besides any claims to which under the conventions of 1839 and 1843 Mexico was adjudged liable. Of the 252 claims put in under this treaty, 182 were finally allowed.

Guadeloupe, gâ-da-loop' (Fr. gwäd-loop), West Indies, an island of the inner chain of the Caribbees. (See ANTILLES.) It lies in lat. 15° N. and lon. 61° W. and, with its dependencies, has an area of 583 to 600 square miles. A strait divides it into two parts, called Basse-Terre and Grande-Terre. The former is mountainous, its highest peaks being La Soufrière (4,900 feet), Deux Mamelles (2,540 feet), Grosse Montagne (2,370 feet), and Caraibe (2,300 feet); and its volcanic character has been manifested most impressively by the eruption of La Soufrière in 1797 and the disastrous

earthquake in 1843. The eastern division, or Grande-Terre, on the contrary, is a calcareous plain, which at no point attains an elevation of more than 450 feet. The mean temperature of Guadeloupe is 78° F., the maximum being 101° and the minimum 61°. The dependencies referred to above are the adjacent islands, Maria Galante, Les Saintes, and Désirade. The chief products are sugar, coffee of the finest quality, and cocoa. Revenues amount to about $1,300,000 to $1,400,000 annually; expenditures, including the appropriations made by France from time to time, are somewhat in excess of that sum. Guadeloupe is a department of France, represented in the French chambers by one senator and two deputies. Its local interests are directed by a governor and a general legislative assembly of 30 members, the jurisdiction embracing one half of St. Martin, besides the islands which have been mentioned. There are nearly 100 elementary schools, with 11,000 pupils, and one *lycée,* with 350 pupils. The chief seaport, Point-à-Pitre, with about 17,000 inhabitants, is situated on the eastern side of Basse-Terre. Several times its buildings have been destroyed or severely damaged; in 1903 minor earthquakes were reported to be of frequent occurrence; and a fresh outbreak from La Soufrière was thought to be not improbable. Le Moule, the principal town of Grande-Terre, resembles Point-à-Pitre in size and situation. After the discovery, Guadeloupe belonged to Spain until 1635; in that year it was taken by the French; in 1794 England seized it, freed the slaves, and retained possession until 1802; then it passed again into French hands, together with Martinique, England taking St. Lucia in exchange; the restoration of slavery by the French was resisted by the negroes, and was attended with great suffering and loss of life; for a brief period in 1810 England once more held Guadeloupe, but returned it to France; emancipation was declared in 1848. The inhabitants are largely French mulattoes, with perhaps 15,000 coolies. Total population, including dependencies, about 167,000. Consult Hill, 'Cuba and Porto Rico, with the other Islands of the West Indies.'

Marrion Wilcox,
Authority on Spanish America.

Guadiana, gwä-thē-ä'nä, a river of Spain and Portugal, which rises in the plateau of New Castile, flows first northwest, then circuitously southwest into and across Estremadura, and on reaching Badajoz turns southwest and forms part of the boundary between Spain and Portugal. Entering Portugal it flows past Monsaraz, Moura, and Serpa, to Mertola, again forms the boundary between the two kingdoms, and falls into the Atlantic between Castro Marim on the Portuguese, and Ayamonte on the Spanish side. Its course is about 515 miles, of which only 35 are navigable. Its chief tributaries are the Gigüela, Bullaque, Valdehornos, and Rubial on the right, and the Azuel and Jabalon on the left.

Guagua, gwä'gwä, Philippines, a pueblo of the province of Pampanga, island of Luzon, on one of the main channels of the Pampanga delta, 3 miles southwest of Bacolor. It is the port for Bacolor, has steamboat communication with Manila, and has an extensive business in groceries and drugs. Pop. 10,700.

Guaiacum, gwī-a-kŭm, a genus of trees of the natural order *Zygophyllaceæ,* natives of tropical America, remarkable for the hardness and heaviness of their wood, known as *lignum vitæ,* or Brazil-wood; also the peculiar resinous product of the common species (*G. officinale*). This is a tree 30 or 40 feet high, usually growing with crooked stem and knotty branches. The wood and resin have been obtained chiefly from Cuba, Jamaica, and San Domingo, but the tree is becoming scarce there. Guaiacum-wood is remarkable for the direction of its fibres, each layer of which crosses the preceding diagonally. It sinks in water. It is much valued and used for pulleys, casters, mortars, bowling balls, and other purposes requiring an extremely firm and durable wood. It is pale yellow on the outside but blackish brown near the heart, where it abounds in resin. Stimulative and other medicinal properties reside in the bark, leaves and resin of this tree.

Guaira, La, lä gwä-ē'rä, Venezuela, a seaport on the Caribbean Sea, five miles in a direct line (29 miles by rail) north of Caracas, of which it is the port. It is situated on a narrow coast strip between high mountains and the sea, and has an unhealthful climate. There are modern harbor works including a breakwater, and a considerable export and import trade is carried on. In 1901 the exports of coffee amounted to 7,290 tons; of cocoa, 3,776 tons; and of hides, 782 tons; the imports include manufactured goods, provisions, wines, etc. The town dates from an ancient Spanish settlement in 1588. In 1903 the port was blockaded by British and German fleets to enforce a settlement of commercial claims. Pop. 14,000.

Gual, gwäl, **Pedro,** South American patriot: b. Caracas 31 Jan. 1784; d. Guayaquil, Ecuador, 6 May 1862. He was graduated from the University of Caracas; joined the patriots in 1810, and was elected as a member of the legislature in 1811. In 1812, when the republicans surrendered, he escaped to New York, but in a few years returned, was made governor of Cartagena, and later sent as ambassador to the United States. He was admitted to the bar in Washington, and began the practice of law, but in 1816 joined Bolivar, was made governor of some of the conquered provinces, and was for a time minister of finance and foreign affairs. In 1858 he joined the revolt against Monagas, and was made president of the provisional government; in 1859 he was elected vice-president of Venezuela, and in 1860 became president, but resigned the next year, retiring to private life.

Gualeguay, gwä-lā-gwī', Argentine, South America, city in the province of Entre Rios; on the Gualeguaychu River. It is a trade centre for a region in which cattle raising is the chief industry. Pop. 7,810.

Gualeguaychu, gwä-lā-gwī-choo', Argentine, South America, city in the province of Entre Rios, on the Gualeguaychu River, 11 miles from its mouth. Its chief industries are connected with the raising and shipping of cattle and wheat. Pop. 14,000.

Guam, gwäm or goo-äm', or **Guajan,** gwä-hän', one of the Ladrone Islands, the southernmost and largest, and the only one with much population; east of the Philippines; occupied by the United States in 1898, the remainder of the group belonging to Germany. It is 29 miles long by 3 to 10 wide, and about 150 square miles in area; high and precipitous

on the eastern side, and forming a low plateau in the northern part, but mountainous in the south. About half the soil is arable, but only about one per cent cultivated. Except for the native clearings, most of it is thick and pathless jungle. Some of the trees are valuable hardwoods for ship-building or ornamental cabinet-work; others are useful for food, as the cocoanut (the finest here of all the tropics), pineapple, breadfruit, sour-sop and custard-apple, etc.; the hau (*Hibiscus tiliaceum*) makes strong cordage, not affected by water; the pandanus' long leaves are braided into mats and hats; and the ylang-ylang is famous for perfume. Rice, sugar, tobacco, hemp, coffee, cacao, bananas, melons, etc., have been introduced and are cultivated. The only native mammals are rats, flying foxes, and bats; but the deer and wild goat, of European origin, have thriven plentifully, and cows and pigs are raised. There are no snakes; there are centipedes and scorpions, but none dangerous. The climate is very rainy, but mild except in midsummer, when the conflict of trade-winds produces a dead calm, oppressive heat, and storms, with some hurricanes. Earthquakes are frequent. The island is volcanic, with bordering coral reefs. The east side has but two good harbors, Pago and Tarofofo; the latter is the only one, except San Luis d'Apra on the west, which is safe for vessels all the year round. The island contains about 9,000 people; Chamorros with a mixture of Tagal and Malay, and some Anglo-Saxons from whaling ships, producing half-breeds with copper skins and light hair. They are nearly all in the villages; those with ranches build rough huts on them, where the family spend part of the time. Agaña (San Ignacio d' Agaña) is the only large town; it is a neat place with houses half of stone and half of wood or bamboo, and contains 6,400 people. Its best port is Apra (above), on a deep bay formed by a peninsula; its own harbor being dangerous in a storm from the anchors dragging on the coral bottom, and the landing bad from breaking reefs. There is a mission school, endowed in the 17th century by Maria Ana, queen of Philip IV. of Spain. Umata, on the west, was the former capital. Agat, 400 people, is next in importance to Agaña; but the next largest in size are Suwai, 900, and Ynarajan, a fair port on the southeast, 550. Merigo has 300. (Wheeler, Report on Guam, 1900, War Dept. doc. 123.)

Guan, gwän, a gallinaceous bird of the family *Cracidæ,* genus *Penelope,* characterized by the front of the throat being naked and wattled; specifically *P. cristata.* It is about 30 inches long, nearly half of which is due to the tail. The color is a shining reddish-green, with rump and belly chestnut, neck and crest white-spotted, and the feet and throat red; the female is of a more reddish tint, with the crest, neck and mantle bordered with white. Though the guans have most of the habits of the curassow (q.v.), they are far less gregarious, noisy and restless. They take to trees when alarmed, roost there at night and often make their nests among the branches. They inhabit the American tropics, one species, the chacalaca (*Ortalis vetula*), ranging into Texas. Guans have long been domesticated in South America.

Guanabacoa, gwä-nä-bä-kō'ä, Cuba, a town well situated on high ground near the city of Havana. The number of its inhabitants shown by the United States War Department census of 1899 was 13,963 (that is, 8,232 native white: 1,091 foreign white; 2,173 negro; 2,408 mixed; and 61 Chinese). The total population of the district of Guanabacoa was 20,080.

Guanaco, gwä-nä'kō. See HUANACO.

Guanahani, gwä-nä-ä-nē'. See CAT ISLAND.

Guanajay, gwä-nä-hī', Cuba, town in the department of the same name in the province of Pinar del Rio, about 30 miles west of Havana. It is situated in a hill region of much salubrity, and is a popular health resort. Here is the terminus of the Havana and Guanajay Railroad. Pop. about 9,000.

Guanajuato, gwä-nä-hoo-ä'tō, Mexico, a state bounded by the states of San Luis Potosi, Queretaro, Michoacán, and Jalisco. Area 20,276 square kilometres, or 7,806.26 square miles. The principal cordilleras traversing the state are the Sierra Gorda, in the northeast, and the Sierra de Guanajuato in the centre, which are formed by the junction of the Codorniches, San Antonio, and Santa Rosa mountain ranges. The highest peaks are the Gigante (2,346 metres) and the Llanitos (2,815 metres). In the south and west are the valleys of San Judas, San Felipe, and Santiago, and the fertile plain of El Bajo. Rivers are: the Lerma, with its affluents the Laja and the Turbio, the Irapuato, and a number of smaller streams. There are many mineral springs, and one lake, 37 1-3 square miles in extent, called the lake of blood (Yuririapundaro). Five mining districts merit special mention; namely, the Sierra Gorda, Allende, Santa Cruz, Guanajuato, and Leon, the principal mines being those which produce silver and gold, silver, mercury or cinnabar, tin, iron, lead or argentiferous lead, and copper or argentiferous copper. On 31 Dec. 1897 there were 550 claims registered, of which number 80 were in process of development. (See statistics given in connection with the department and city of Guanajuato.) The climate, except in the higher parts of the mountain ranges, is not unfavorable (mean annual temperature about 70°). The rainy season extends from the middle of May until the beginning of July. During those months the rainfall is heavy in the valleys, but only moderate in the mountains. The value of agricultural products in 1897 was given as follows: Corn, $7,000,000; barley, $190,000; wheat, $5,000,000; chile, $490,000; tobacco, $32,000; wool, $80,000. The total value of live stock was estimated at $10,000,000. The state is regarded as the most important mercantile centre of the republic. Its total trade, estimated at $67,000,000 per annum, is distributed as follows: Exports of minerals to Mexico city, the United States, and Europe, $20,000,000; exports of agricultural and other products to Mexican States, $10,000,000; exports of manufactured products, $2,000,000; imports from Mexico city, the United States, and Europe, $12,000,000; imports from other Mexican states, $3,000,000; the balance consisting of local trade. The chief imports are groceries, ready-made clothing, textiles, hardware, drugs, arms and ammunition, hats, canned goods, agricultural and mining machinery, and tools. There are 350 woolen mills, 853 cotton mills and 72 flour mills; also saddleries, potteries, powder-works, distilleries, tanneries, and foundries. Railway lines traversing

the state are the Mexican Central, Mexican National, and Salamanca and Valle de Santiago. Principal towns have street-railways. The telegraph, telephone, and postal services of the state are moderately efficient. The state is divided into five departments, sub-divided into 31 partidos. Departments, with their chief towns, are: Allende, population, 161,904, principal towns San Miguel Allende and Dolores Hidalgo; Celaya, population, 277,321, principal town of the same name; Guanajuato, pop. 387,718, its principal town, of the same name, being the capital of the state (see GUANAJUATO CITY); Leon, population 142,157, principal towns Leon de los Aldamas and San Francisco del Rincón; and Sierra Gorda, population 93,456, principal towns San Luis de la Paz and San José de Iturbide. Consult 'Mexico: a Geographical Sketch' (Washington, 1900).

Guanajuato City, Mexico, capital of the state of Guanajuato. It is situated in a narrow valley on the Guanajuato River, 252 miles by rail from Mexico city. Principal buildings are the state government palace, the Palace of Congress, mint, state college, churches, two theatres, hospitals, a bull-ring, Market de la Reforma, Pantheon, and the Castle of Granaditas, where the heads of the patriots Hidalgo, Allende, Aldama, and Jimenez were hung on iron hooks during the war for independence. This city is the commercial centre of the state, and one of the most important in the republic. It is connected with the Central Railway by a branch line, and has street-railways, electric lighting, and other modern improvements. The mineral wealth of the district is indicated by the following figures: From 1812 to 1896 the combined value of gold, silver, and copper coined by the Guanajuato mint was $309,077,468.25, Mexican silver, the gold coinage being estimated at $21,178,328; silver, $287,884,476.25; and copper, $14,664. Pop. 53,000.

Guanare, gwä-nä'rā, Venezuela, city, capital of the state of Zamor, near the Guanarito River, about 220 miles southwest of Caracas. Coffee and sugar-cane are some of the chief agricultural productions; but the city is the centre of an extensive cattle trade. Pop. about 11,500.

Guanes, gwä-nās', or **Guane,** Cuba, town in the province of Pinar del Rio; about 10 miles from the sea, and 120 miles southwest of Havana. The district court holds its sessions here. The trade in the products of the surrounding country, cotton, tobacco, and cattle, is extensive. There is also a large trade in lumber. Pop. (1899) 14,760.

Guan'idin, a basic organic substance, having the empiric formula CH_5N_3, and the constitutional formula $HN{:}C(NH_2)_2$. It may be prepared by heating an alcoholic solution of cyanamide and ammonium chlorid to 212° F. Guanidin is a crystalline, deliquescent substance, with strongly alkaline properties, and it absorbs carbon dioxid from the air. It forms numerous salts, and urea is evolved in many of its reactions. In fact, it is this close relation with urea that gives guanidin its chief interest, many authorities holding the opinion that guanidin is an intermediate product in the formation of urea from proteid bodies, in the normal physiological chemistry of the body.

Guanin, gwä'nĭn, a yellowish-white, amorphous substance, which derives its name from being a constituent of guano; but it also forms the chief constituent of the excrement of spiders, has been found attached to the scales of fishes, and seems to be a normal constituent of the mammalian liver and pancreas. With regard to its occurrence in guano, as it has not been found in the recent excrement of sea-birds, there is every reason to believe that it is formed by slow oxidation (from atmospheric action) of uric acid, much as uric acid can be made to yield urea and oxalic acid. And in the pancreas and liver it probably represents one of those transitory stages of disintegrated nitrogenous tissue which are finally excreted by the kidneys in the more highly oxidized form of urea. Guanin is a diacid base, but also forms salts with metals, and combines with salts. When heated with hydrochloric acid and potassium chlorate, it is oxidized to carbon dioxide, guanidin, and parabanic acid.

Guano, gwä'nō, Spanish, *guano huano*, from Peruvian *huanu*, dung, is the name for deposits of the partially decomposed and dry excrementitious matter of sea-birds. but it has been also extended to accumulations of a similar kind from land-birds, and even from bats in caverns. Deposits from sea-birds are got wherever there is good feeding-ground in the neighborhood of unfrequented islands and rocky cliffs, and such may be seen around many shores. But to render them of practical utility atmospheric conditions are requisite which are only found in certain localities, and all the great guano deposits exist in the hottest and driest parts of the tropics, as on the islands of the South Pacific Ocean. The most important of all were the deposits on the Chincha Islands off the coast of Peru, which for years yielded a considerable revenue, but are now quite exhausted. The guano which was found there was from 60 to 80 or 100 feet in thickness, and was entirely due to the droppings, accumulated for many ages, of the innumerable sea-birds which make these islands their resting-place and breeding-ground. The excrement which is at first pasty, rapidly dries by exposure to the sun in a part of the world where a fall of rain takes place once in a lifetime, and is looked upon as an historical event, and thus, while putrefaction is almost entirely arrested, the soluble salts of which guano to a great extent consists are retained. This guano, called technically Peruvian, is the most highly prized, and is regarded as a type of the substance; but quantities are or have been got from other localities, as Patagonia, various points of Bolivia, Mexico, and Chile, Malden Island and numerous other Pacific islands, new deposits being opened up as the older become less productive.

Guano varies extremely in composition, even in the same deposit considerable differences will be found; and when deposits from different localities are compared, there is sometimes no analogy except in the kind of substances present. Thus, some consist mainly of phosphate of calcium and other fixed salts, while others contain much volatile matter, with a large proportion of ammonia. To the latter belongs Peruvian guano, which is a very light, dry, non-cohesive pale-yellow powder, with a characteristic ammoniacal odor, and sometimes containing lumps, made up of different salts. It is a very complex mixture, containing the urate of ammonium, the oxalates

of ammonium and calcium, the phosphates of sodium, ammonium, calcium, and magnesium, the sulphates of potassium, sodium and ammonium, the chlorides of sodium and ammonium, and the carbonate of calcium. There is always some moisture, organic matter of different kinds, sand from the rock on which the deposit lies, and this is sometimes considerable. These may be regarded as the possible constituents of guano, but the ingredients which are especially prized are the ammoniacal salts, the phosphoric acid, in combination with the alkalies and alkaline earths, and the alkalies themselves, particularly the potash. It is the remarkable abundance of these constituents and their fine intermixture which makes genuine Peruvian guano so much esteemed as a manure. It contains almost all the inorganic matter required by a plant, and that in a highly available form, so that it is one of the best of all fertilizing agents for different crops. Its use as a manure was known to the native Peruvians centuries ago, but no attention was paid to the accounts by modern travelers of its wonderful efficacy until A. von Humboldt took some to Europe, in 1804, and had it analyzed. It was not exported on a large scale till about 1850, and from that time the quantity sent to foreign countries, including large shipments to the United States, was very great, but the supply has latterly much fallen off.

As a substitute for ordinary guano, what is known as fish-guano has been in use for a considerable number of years. This consists essentially of fish and fish offal dried and powdered. In the case of oily fish, such as herrings, it is necessary to extract as much of the oil as possible before the operation of powdering; and it will thus be understood that different kinds of fish differ greatly as regards their value for manurial purposes. But all sorts of fish-guano contain a large percentage of ammonia and phosphate of lime, and are thus valuable as fertilizers.

Guanta, gwän-tä', **Venezuela**, a modern seaport on the north coast, in the state of Bermudez, 12 miles west of Barcelona, by rail.

Guantanamo, gwän-tä'nä-mō, Cuba, a town in the province of Santiago, situated at the head of the most important harbor east of the city of Santiago on the southern coast. Its surroundings were favorably known before 1898, for the beauty of the groves of lime-trees and lemon-trees, the coffee plantations, and the residences of wealthy planters, who made the heights overlooking the bay a favorite place of resort. Since the Spanish-American war, Guantanamo has been famous as the scene of certain military operations. On 19 May 1898 an unsuccessful attempt to cut the cable in the bay was made by the St. Louis and the Wompatuck. On 10 June a force of 600 marines landed from the transport Panther on the eastern shore of Guantanamo Bay, and undertook to make the outer harbor a secure place for the use of American vessels when coaling, or as a rendezvous and a refuge in stormy weather. The marines established their camp ("Camp McCalla") on a small hill, where they sustained the attacks of the Spanish troops for several days; and the courage and endurance displayed at this time must be regarded as memorable features of the war. The Marblehead and Texas lent assistance, the latter on 12 June sending 40 marines with two automatic guns. In the course of that week the camp was protected by earthworks; other warships arrived and shelled the thickets in which the Spaniards were concealed, the forts, and the town; the garrison was strengthened by accessions of bluejackets and Cuban insurgents familiar with the country; and thus, when ten days had passed, the outer harbor was practically in the possession of the American forces. In July 1901 the United States government selected Guantanamo for one of the four naval stations on the Spanish coast. The number of inhabitants of the town of Guantanamo, according to the United States War Department census of 1899, was 7,137. The total population of the district was 28,063, comprising native white, 7,028; foreign white, 1,843; negro, 8,988; mixed, 10,025; and Chinese, 179.

Marrion Wilcox,
Authority on Spanish America.

Guaporé, gwä-pō-rā', or **Itenez**, ē-tā-nāz', a South American river which rises in the Serra Aguapehi, in the state of Matto Grosso, Brazil, flows south, nearly parallel to the Jauru, passes the town of Matto Grosso, whence it is navigable downward for light draught vessels, then with a northwesterly trend forms part of the boundary between Brazil and Bolivia, and finally after a course of over 960 miles, unites with the Mamoré to form the Madeira.

Guarana, gwä-rä'nä, a dried paste consisting chiefly of the crushed or pounded seeds of *Paullinia sorbilis*, a climbing shrub, native of South America. The seeds are obtained largely from the cultivated plants, and in South America guarana is used much as tea or coffee is used in other countries. It is the staple drink of millions of people. Guarana is found in the drug market in the form of flattened cakes or cylinders of a dark reddish-brown color and showing on fracture numerous coarse angular fragments of seeds. The taste is astringent and somewhat bitter, becoming sweet on chewing. Guarana contains four to five per cent of caffeine, making it twice as strong as coffee. Its action, however, resembles more closely that of tea because of the high percentage of tannic acid it contains. In medicine it has been used in the treatment of sick-headache.

Guarana-bread, the seeds of the *Paullinia sorbilis* (a South American tree), pounded, made into cakes, and dried in the sun. It is extensively used in Brazil and other parts of South America as a stimulant and restorative, and as a material for making a refreshing beverage. The active principle of guaranine, is said to be identical with theine or caffeine (q.v.); and no known substance yields it so abundantly. Other species of *Paullinia* possess poisonous properties.

Guarantee, gär-an-tē', or **Guaranty**, in law, an undertaking to answer for the failure of another. The statute of frauds provides that no person shall be liable on any special promise to answer for the debt, default, or miscarriage of another person, unless a written agreement, or some memorandum in writing for such purpose, shall be signed by the promisor or some other party lawfully authorized by him. In the construction of a guarantee it is a general rule that the surety shall not be bound beyond the express words of the engagement. By the mercantile Law Amendment Act (England and Ireland), no special promise made to answer for the debt, default, or miscarriage of another is deemed

invalid to support an action, by reason that the consideration for such promise does not appear in writing, or by necessary inference from a written document. By a similar statute applying to Scotland, and passed in the same year, all such guarantees must be in writing, and if for a firm will cease upon a change of the members, unless intended by the parties by express stipulation or implication to be binding notwithstanding the change in the firm. Every person who becomes surety for the debt or obligation of another, and discharges his liability, is entitled to the assignment of all securities held by creditors. In the United States the common law on the subject of guarantee or suretyship was the same as that of England and a guarantee was equally forcible whether written or oral, but see SURETYSHIP.

Guard, National. See MILITIA.

Guardafui, Cape. See CAPE GUARDAFUI.

Guardi, Francesco, frän-chĕs'kō gwär'dē, Italian painter: b. Venice 1712; d. there 1793. He was a pupil and follower of Canaletto; his work shows less exactness in detail than his master's, but is superior in use of color. His paintings are mostly of scenes in Venice; they include 'Procession of the Doge'; 'Fete of Corpus Domini'; 'Grand Hall of the Palazzo Ducale' (in the Louvre, Paris); 'Church and Piazza of San Marco' (National Gallery, London); and 'The Rialto' (Metropolitan Museum, New York).

Guardian Angel, an angel who watches over a particular individual. It is the general belief, in the Roman Catholic and Greek Churches that every man has a guardian angel who defends him from evil, suggests good thoughts and wise counsels, and helps him in prayer. This belief is based on the words of Christ in Matt. xviii. 10: "Their angels do always behold the face of my Father which is in heaven"; the Fathers of the Church strongly inculcate it, and in the lives of the saints instances are given of the active interference of guardian angels. The belief is shared by some Anglican high churchmen. The Roman Catholic Church celebrates the Feast of Guardian Angels on 2 October. See also ANGEL; GUARDIAN SPIRIT.

Guardian Spirit, a spirit that watches over the welfare of an individual or household. The belief in guardian spirits finds expression in some form in all primitive religions, and in many which have reached a higher stage of development. The Australian native believes that when a warrior kills his first foe the spirit of the slain enters the body of the slayer, and becomes his guardian; in Tasmania a native has been heard to ascribe his deliverance from danger to the care of his deceased father's spirit; and the most important religious rite of a North American Indian is to obtain a patron genius. In Asia, in Africa, and among the Indians of South America, the belief in guardian spirits obtains, as it did formerly among the Aryans of Northern Europe. Greeks and Romans believed that each individual was under the protection of a spirit who prompted him to good deeds, and guided him throughout his life; gradually there arose a belief in an evil spirit who was at war with the good spirit, and instigated every evil deed. These spirits were called in Greece, Dæmons, in Rome, Genii. The Romans also believed that the spirit of the founder of each family was the guardian spirit (the Lar) of the family and worshipped the Lares with special rites. For the Christian form of the belief see GUARDIAN ANGEL.

Guards. A guard, in the primary sense, is one who watches or protects a person or persons, a place, property, etc., against loss, danger, or harm; as a body-guard, a prison-guard, etc. Body-guards have been an inseparable accompaniment of monarchy from the earliest ages; the Assyrian and Persian kings employed them, and the corps of "Argyraspides," or silver-shields were selected by Alexander out of the bravest men of his army. The Roman emperors had their Prætorian guard. Napoleon I. first created a small troop of bodyguards, with the title of Guides, while he was yet only general, in his first Italian campaign. From this arose by degrees, the great institution of the Imperial Guard, consolidated in 1804, which 10 years later comprised 102,708 men, and after being disbanded by Louis XVIII. in 1815, was restored by Napoleon III. in 1854. It consists of infantry, cavalry, and artillery. In England, the Guards, otherwise called household troops, consist of two regiments of Life Guards, the royal regiment of Horse Guards, and three regiments of Foot Guards. Many of the European sovereigns before the French Revolution had small corps of foreign troops which served in this capacity. Thus the French had, in former times, the Guard of Scottish Archers, and at a later period, a body of Swiss guards, called the Cent Suisses. The Cent-Gardes formed by Napoleon III. are founded upon the latter. The Pope still retains his Swiss guards. In Prussia there is both infantry and cavalry of the guard, and the Russian imperial guard forms an entire corps d'armée 50,000 strong.

In general military use the term guard is of various distinct applications and denotes functions of great importance. It means a sentry on duty, and also a body of soldiers assigned, under the proper officer or officers, to the duty of guarding or protecting a camp, post, or any place where military control is established. Company and regimental details for guard duty are made according to circumstances — the number of men required or available, etc.,— rank of officers being also regarded as far as convenient. Guard-mounting or inspection and review before the old guard is relieved, is a ceremony of much detail and is usually carried out with strict military observance.

Guasa, gwä'sä, or **Warsaw,** a name given in the Gulf of Mexico and West Indian region to various large groupers (q.v.), especially the jewfish (q.v.). "Warsaw" is an anglicized form of the Spanish word.

Guatemala, Republic of (República de Guatemala), the largest country in Central America; bounded on the north by Mexico, British Honduras, and the Gulf of Honduras; on the east and southeast by British Honduras, the Gulf of Amatique, Honduras, and Salvador; on the south and southwest by the Pacific Ocean; and on the west by Mexico. Its area is estimated at 47,810 or 48,290 square miles; its territory extending from lat. 13° 42' to 17° 49' N., and from lon. 88° 10' to 92° 30' W.

Political Divisions.— Guatemala is divided into 22 departments, and each department subdivided into municipal districts, the total number of the latter being 331. Again, for electoral purposes, the whole republic is divided into 38 *distritos electorales.* The following list of the departments and chief towns shows the population and altitude of the latter. The figures given for the number of inhabitants are those of 1903 in the case of Guatemala City, Cobán, and Totonicapam; otherwise the statement is based upon a table carefully prepared in 1897.

Northern departments are: Baja Verapaz (chief town Salamá, population 10,608, altitude 2,827 feet); Alta Verapaz (chief town Cobán, population 24,475, altitude 4,047 feet); El Petén (chief town Flores, population 1,671, altitude 482 feet); El Quiché (chief town Santa Cruz, population 11,914, altitude 5,543 feet); and Izabal (chief town Livingston, population 1,978).

Central departments are: Guatemala (chief town Guatemala City, population 72,102, altitude 4,854 feet); Sacatepéquez (chief town Antigua, or Antigua Guatemala, population 10,150, altitude 4,464 feet); and Chimaltenango (chief town Chimaltenango, population 3,749, altitude 5,666 feet).

Eastern departments are: Jutiapa (chief town Jutiapa, population 11,023, altitude 2,847 feet); Jalapa (chief town Jalapa, population 12,246, altitude 4,625 feet); Chiquimula (chief town Chiquimula, population 12,562, altitude 1,167 feet); and Zacapa (chief town Zacapa, population 11,964, altitude 511 feet).

Southern departments are: Escuintla (chief town Escuintla, population 12,343, altitude 1,269 feet); Amatitlan (chief town Amatitlan,* population 8,408, altitude 3,614 feet); and Santa Rosa (chief town Cuajiniquilapa, population 3,062, altitude 3,254 feet).

Western departments are: Huehuetenango (chief town Huehuetenango, population 10,279, altitude 7,118 feet); Totonicapam (chief town Totonicapam, population 25,196, altitude 7,967 feet); San Marcos, chief town San Marcos,* population 6,036, altitude 7,216 feet); Quezaltenango (chief town Quezaltenango,* population 22,265, altitude 7,419 feet); Retalhuleu (chief town Retalhuleu, population 6,327, altitude 977 feet); Suchitepequez (chief town Mazatenango,* population 6,970, altitude 1,095 feet); and Sololá (chief town Sololá,* population 7,627, altitude 5,940 feet).

The Capital.— Guatemala City, or New Guatemala, which was built after the destruction of Antigua Guatemala in 1776, has a temperate climate, owing to its elevation above the level of the sea. It is a well-planned town, covering a large area; the streets are wide and straight, lighted by electricity, and have lines of street railways. Principal buildings: the palace of the president, city hall, court-house, post and telegraph office, artillery barracks, custom-house, liquor and tobacco bureau, national theatre, college of medicine and pharmacy, university, school of arts and trades, polytechnic school, palace of the archbishop, the cathedral and several other fine churches, the penitentiary, and the hotels. The city has public gardens, telephone and telegraph service, and is connected by rail with the port of San José. Pop. 74,527.

Topography and Physical Geography.— The mountains of Guatemala are commonly referred to as "Cordillera of the Andes," "Guatemalan Andes," or simply "Andes," though there is no propriety in those names. The Andes terminate in northern Colombia, and have no genetic connection with the mountains of Central America. In order to understand the independent character of the latter (so far as the great continental ranges are concerned), we must realize that they are also in their geologic history totally distinct from the Rocky Mountain system, or North American Cordilleras, which terminate in southern Mexico. If the trends of the Andean and Rocky Mountain systems were protracted from their termini (in 70° W. and 97° W., respectively), they would not connect with each other, but would pass the latitude of Guatemala in parallel lines nearly 2,000 miles apart. (See CARIBBEAN SEA; CENTRAL AMERICA; and consult: Hill, 'Cuba and Porto Rico,' Chap. I.). The Guatemalan mountains belong to the Antillean system, which lies between the termini just referred to; its ranges, composed of folded sedimentaries, in eastern Guatemala have an east-and-west trend. But the ranges near the Pacific coast of the republic, crossing the western ends of the Antillean corrugations diagonally, or with a northwest-and-southeast trend, must be assigned to still another class; they form a part of the volcanic chain which extends along the entire western coast of Central America, and is continued in Mexico. The Sierra Madre is the principal range of the west and south; in the central and eastern districts are the Sierra de Chama, Sierra de las Minas, Sierra de Santa Cruz, and the Sierra de Copán — the last named on the frontier of Honduras. The highest points of the Cordillera are given as: Tajumulco volcano (12,600 feet), Tacaná volcano (12,400 feet), both in the southwest; Acatenango volcano (11,100 feet), south-central; and the volcano de Fuego (11,400 feet), also south-central.

Hydrography.— Rivers emptying into the Gulf of Mexico are: the Usumacinta, on the Mexican frontier, and the Cuilco and Salequa, which are also tributaries of Mexican streams. The following empty either into the Gulf of Honduras or Izabal Lake (Golfo Dulce): the Montagua, Rio Hondo, the Dulce, the Belice, the Sarstoon, and the Polochic. Those which flow into the Pacific are: Rio de los Esclavos, Rio de Paz, the Michatoya, Guacalate, Coyelate, Patulul, Nagualate, Samalá, Tilapa, Naranjo, and Suchiate. Steamship navigation has been established on the Dulce and Polochic rivers; seven or eight of the others are navigable for small boats. The most important lakes are: Atitlán and Izabal (both navigated by steamers), Petén, Amatitlán, Ayarza, and Güija (on the frontier of Salvador). Ports on the Caribbean side of the republic are: Puerto Barrios, Livingston, and Santo Tomás — the first two being ports of entry and delivery, while the last is a "minor port," at which importation and exportation are restricted to certain articles. On the Pacific coast the most important ports are: San José, 74½ miles from Guatemala City; Champerico, and Ocós — all ports of entry and delivery, provided with iron piers, etc.

Geology.— The calcareous formations of the Antillean ridges and, generally, the eastern and

---

*Towns damaged or destroyed by earthquakes in 1902.

central regions, deserve special mention. Volcanic products characterize the Pacific slope and Sierra Madre, where they occur in connection with granitic rocks, porphyries and trachytes. See also CENTRAL AMERICA.

Mineral Resources.— Gold and silver are found near the Montagua River and elsewhere; salt in the departments of Alta Verapaz and Santa Rosa. Other minerals reported to exist are: coal, lignite, manganese, lead, tin, cinnabar, copper, kaolin, opals, slate, alum, antimony, marble, alabaster, sulphur, ochre, asbestos, plumbago, chalk, and bitumen. A belt of country extending from the coast range of mountains on the western frontier, near the Pacific, across the Sierra Madre to the coast range of the Caribbean slope, is regarded as essentially a mineral territory, in which there has been comparatively little exploiting or prospecting, though enough to reveal the presence of the precious and base metals.

Climate.— The lowlands of the Pacific and Atlantic coasts are torrid; interior table-lands, at an altitude of 2,000 to 5,000 feet, have an agreeable climate; and the high districts, where the elevation is more than 5,000 feet, are decidedly cool. As is shown in the list of places given under «Political Divisions,» the larger towns are built in the temperate or cool zones. The rainy season, beginning in May, lasts until October in the interior, but sometimes until December, on the coast. December and January are the coldest months; March and April the hottest. Snow sometimes falls (in December or January) on the uplands of the cool zone.

Flora and Fauna.— The very name of the country signified in the Indian language «the land covered with trees.» The rich soil and varying climatic conditions favor a wide range of products in the vegetable kingdom; no systematic classification of these, however, has yet been made. The extent of the forest land, which abounds in mahogany, is estimated at 1,300,000 acres. The fauna and avifauna resemble those of Costa Rica in general, but especially characteristic of Guatemala are the aquatic birds on its rivers and lakes, and the quetzal. Mexican deer are quite numerous. The tapir, honey-bear, armadillo, wild pig, cougar, jagua, etc., are found as in other parts of Central America. The over-abundance of insect life is particularly noteworthy.

Land Tenure.— The most interesting provisions of the Guatemalan laws, to be considered under this heading, are those which relate either to the public lands or more particularly to the aid which the government desired to extend to the cultivators of certain crops. The latter will be stated in the paragraph entitled *Agriculture.* As for the former, the agrarian law of 1894 provided for the sale, lease, and gratuitous concession of the public lands, and created a board of government engineers to survey the said lands and divide them into lots of not more than 15 caballerias each. (One caballeria in Guatemala = 113⅝ acres.) These lots can be purchased from the government at prices ranging from $250 to $500 per caballeria, but no alien is allowed to hold lands situated on the frontier of the republic; or they may be leased (under certain restrictions as to area, duration of lease, and use of the lands) at a rental not to exceed 5 per cent of the selling price; or they may be granted by the president of the republic, in tracts not larger than two caballerias each, to poor persons applying for them, to immigrants, to educational institutions, as a reward for the construction of new roads, etc. Real estate, the value of which does not exceed $1,000, is exempted from taxation. Transfers of unimproved city lots, or of real estate in the country the price of which does not exceed $100, cannot be taxed; and no foreigner can be required, during the first year of residence in the country, to contribute money or personal service for making or repairing roads.

Agriculture.— Coffee grows in the regions between 1,000 and 6,000 feet above the sea-level; sugarcane, between sea-level and 6,200 feet; cacao in the lowlands or those regions having an altitude of less than 3,000 feet. Tobacco, wheat, maize, and beans, are also produced in large quantities. Coffee exports in one year have amounted to 85,373,223 pounds, with a value of $7,390,477 gold. The ordinary annual yield of tobacco is given as 1,000,000 pounds; of cane-sugar, 41,000,000 pounds; bananas, 1,000,000 bunches; and cacao, 200,000 pounds. Stock-raising has been encouraged in the departments of Izabal, Zacapa, Petén, and Alta Verapaz, by decrees authorizing the political chiefs of those departments to make grants of land to persons who establish ranches. Money premiums have been offered to cultivators of india rubber, cacao, sarsaparilla, and hemp; grants of land to those who engage in the cultivation of wheat and bananas. Proprietors of large cotton or tobacco plantations, and reliable day laborers on large plantations of coffee, sugarcane, bananas, or cacao, are exempted from military service. No tax of any kind is levied for 10 years upon plantations of hemp, flax, ramié, cotton, grapes, and one or two other products. Large cash premiums to encourage the production of grapes, hemp, cotton, flax, wheat, and tobacco were offered, particularly during the decade 1886–96; in 1899 the government offered 113⅝ acres of the public lands as a reward for every 20,000 rubber-plants, four years old, planted after 14 Jan. 1899.

Commerce.— Exports to the United States in the fiscal year ending 30 June 1902 were valued at $2,600,000; imports from the United States at $1,680,000. The principal exports for 1901 were: Coffee, 673,344 hundred-weight, sent to Germany, the United States, and Great Britain; sugar, 55,200 hundred-weight, sent to other Central American countries and to the United States; bananas, 262,691 bunches, sent to the United States; hides, 7,018 hundred-weight, sent to Germany and the United States; india rubber, 4,420 hundred-weight, sent to the United States and Germany; timber, 2,155,696 feet, sent to Great Britain and the United States; and other articles valued at $55,000. Of the imports, about one half in value are supplied by the United States, and one quarter by Great Britain, the chief imports being flour, cotton goods, machinery and manufactured iron, and preserved meats and other articles for food. Both exports and imports have increased in value during recent years.

Manufactures.— For the partial supply of local needs a number of small establishments are maintained, the chief industries being the preparation of ramié fibre and the manufacture of coarse textiles, hats, shoes, pottery, cigars,

foundry products, musical instruments, furniture, agricultural implements, and liquors.

Shipping and Navigation.— Steamers of the Pacific Mail Steamship Company call at San José three times each month on the voyages from San Francisco southward. From New York to Puerto Barrios (via Haiti and Jamaica) passengers and freight are carried by two steamship lines. The steamers of the American Fruit Company ply between New Orleans and Puerto Barrios; and in 1903 announcement was made of a new steamship service, the "Guatemala Northern Steamship Line," to operate chiefly between ports on the gulf coast of the United States and Puerto Barrios.

Railways, Roads, Telegraph, etc.— The Central Railway, the first line built in the republic, was completed in 1882. It connects the port of San José with Guatemala City. The Champerico Railway runs from the Pacific port of that name to Retalhulen and San Felipe, a distance of 41 miles. The Ocós Railway, 15 miles in length, connects the wharf at Ocós with the town of Ayutla, near the Mexican frontier. The Ixtapa Railway connects Overo with the old port of Ixtapa (12 miles). The Patulul-Mazatenango Railway has as its terminal points Santa Maria station, on the Central, and San Felipe, passing through Patulul and Mazatenango. The Northern Railroad, which is to connect Puerto Barrios with Guatemala City (and thus, in conjunction with the Central, to supply railway transportation from coast to coast), had completed 159 miles of its road in March 1902. An important highway from Sanarate has been completed, giving access to the northern agricultural districts. The republic has in operation more than 3,000 miles of telegraph wires, 137 kilometres having been added in 1901–2; and the telephone system extends over 250 miles. Receipts from telegraph and telephone lines were greater by $136,042.97 in 1902 than in 1901. The operation of the postal system in 1902 left a considerable surplus in the treasury.

Weights, Measures, and Money.— The French metric system is used, concurrently with the old Spanish system of weights and measures. The latter has: *Onza* (ounce), *libra* (pound, strictly 1.043 pounds), *arroba* (25 *libras*), *quintal* (100 *libras*), *tonelada* (ton 20 *quintals*), and *fanega* (1½ bushels). The monetary unit is the silver *peso* (value in United States gold or silver, $0.384). The money in actual use is paper currency and fractional nickel coins.

Banking.— Six banks are authorized to issue paper, namely: International Bank of Guatemala (Banco Internacional de Guatemala), Colombian Bank (Banco Colombiano), Western Bank (Banco de Occidente), Commercial Bank of Guatemala (Banco Comercial de Guatemala), American Bank (Banco Americano), Guatemala Bank (Banco de Guatemala). All of these, except the Banco de Occidente, have their headquarters in Guatemala City.

Government.— The legislative power is vested in the National Assembly (a single house), whose members (deputies) number one for every 20,000 inhabitants, and are elected for four years by popular vote. The executive power is vested in a president, elected for six years by direct vote of the people. He is responsible for his acts to the assembly, and cannot be re-elected until after an interval of at least one term. The administration is carried on, under the president, by six "secretaries of state," each of whom has charge of a separate department (*ministerio*). These departments are: Government and Justice, Foreign Relations, Public Instruction, Promotion of Public Welfare (*Fomento*), Finance and Public Credit, and War. The council of state is an advisory board, of which certain members are chosen for the assembly and others appointed by the president.

Finances.— The national revenue in 1901 is shown in the following table:

Customs	$8,513,260.88	
Expenditure	7,855.85	
		$8,505,405.03
Liquor excise and government monopolies	$3,775,892.98	
Expenditure	117,687.15	
		$3,658,205.83
Taxes	$1,651,246.55	
Expenditure	72,588.45	
		$1,578,657.10
Total		$13,742,268.96
Deficit from post-office	$110,617.48	
Deficit from telegraph office	193,541.32	
		$304,158.80
Net total		$13,438,110.16
Revenue in 1900		7,974,435.40
Increase in revenue		$ 5,463,674.76

The sum of $14,547,246.72 was appropriated for administrative expenses in the fiscal year extending from 1 July 1902 to 30 June 1903, with the following distribution: Government and justice, $1,874,392; foreign relations, $256,180; treasury, $1,199,986; public credit, $6,000,000; development, $1,458,279; war, $2,006,154.40; public instruction, $1,442,900; other expenditures, $309,376.32. The revenue for the year was estimated at $14,555,000. The total amount of the foreign debt liquidated to 30 June 1902, according to an official statement, was:

Principal on 30 June 1898	$7,216,046
Half of interest from 1898 to 1901, convertible in bonds	432,963
Half of interest to 30 June 1901	288,642
Interest for 1901 to 1902	288,642
Total	$8,226,293

On 31 Dec. 1900 the outstanding amount of the gold debt was $9,231,202, and of the currency debt $27,709,666.

Army.— The army consists of about 7,000 men in regular service; effective army, 56,900 men between the ages of 18 and 30; reserve, 30,000 men from 30 to 50 years of age.

Population.— Full-blooded Indians are much more numerous in Guatemala than in other Central American countries; in fact they, with the Indians of mixed blood, *ladinos* and *mestizos*, make up the bulk of the population. The natural increase among these people is indicated in the report of the secretary of public works for 1901, which shows 66,728 births in that year against 35,618 deaths, a gain of 31,110 persons. The total number of inhabitants in 1903 was about 1,700,000, including 11,000–12,000 foreigners.

Education.— Public instruction, supported by the government, is secular and gratuitous; primary instruction is obligatory; free education is guaranteed by the Constitution. In 1901 there were 1,030 schools in the republic, 455 being for males, 379 for females, 146 mixed, and 50 night schools. In Guatemala City there were 53 schools, of which number 25 were public,

under government inspection; and among the private institutions was a school for boys and girls of the German colony only, endowed by the German government. Higher instruction was given in the capital at the National Institutes (one for men and one for young women), to which normal departments were attached; and similar institutes existed at Quezaltenango (before its destruction) and Chiquimula. There is a separate normal school for young women at Guatemala City, and normal schools for young men at Antigua, San Marcos, and Mazatenango. Schools of law, medicine, and engineering are mainly supported by private funds, but receive aid from the public treasury. Education in music is supplied at the National Conservatory and a number of local schools. There are also trade schools (including one for women) a commercial college, and an art school. The national library contains 30,000 volumes and many valuable unpublished documents. Other libraries accessible to the public are those of the professional schools, the supreme court, national institute for men, and academy of teachers. Public libraries are maintained in the larger towns. The national printing-office at the capital is regarded as one of the best establishments of its kind in Latin-America. More than 30 daily papers and other periodicals are published in the country.

Religion.— The Constitution guarantees liberty of conscience. The government recognizes no creed. The prevailing religion is Roman Catholicism.

Judiciary.— The supreme court of justice consists of a chief justice and four associates, elected by the people. There are six courts of appeal, each consisting of a chief justice and two associates, also elected by the people. Courts of the first instance are 29 in number: their judges are selected by the president among the candidates approved by the chief justice of the supreme court.

Local Government.— The "Political Chief" (*Jefe Politico*) of each department of the republic is appointed by the president, whose authority he exercises in provincial matters. The local officials locally elected are: the *Alcaldes* (one or more for each municipal district) and the *Regidores* (members of the municipal council). *Alcalde* and *Regidor* correspond to mayor and alderman; the *jefe politico* takes the place of a governor, and his relation to the chief executive in a centralized republic fairly indicates the limits within which local self-government is permitted.

History.— Pedro de Alvarado, one of the lieutenants of Cortés, in 1523–4 conquered the country, and on 25 July 1524 proclaimed the sovereignty of Spain at Almolonga, the native town which was afterward to be known as Santiago de los Caballeros. The important fact in connection with this conquest is that it did not lead to the extermination of the natives. Two explanations of this circumstance are offered. Mr. Bancroft says that the Indians, after fighting desperately in defense of their homes, maintained a sullen resistance, and therefore both here and in the adjoining state of Chiapas "the natives probably retain to the present day their original traits with fewer modifications than elsewhere in the Pacific States." But this theory is at variance with the Central American records in general. A suggestion which may be preferred is that the natives of Guatemala were essentially peace-loving agriculturists, not uninfluenced by that civilization which had survived here, as in southern Mexico and Honduras, from very ancient times; that they were allowed to remain undisturbed after the first resistance ceased, while the more warlike tribes, such as those inhabiting Costa Rica and Veragua, were gradually being exterminated. And their descendants in great numbers still possess the land. After the conquest all of the territory now divided up among the Central American countries was included in the captain-generalcy of Guatemala. Independence was proclaimed 15 Sept. 1821; annexation to the Mexican empire under Iturbide followed (5 Jan. 1822). An assembly of representative citizens of Guatemala and the other Central American provinces on 1 July 1823 declared the whole country to be independent, with reference to Mexico, Spain, and all other nations, "whether of the Old or of the New World." Accordingly the United Provinces of Central America came into existence. Guatemala seceded from this union 17 April 1839. The name República de Guatemala was assumed 21 March 1847. Between 1839 and 1851 there was a series of bitter struggles with Salvador for supremacy, fortune favoring the smaller republic; but in the year last mentioned Guatemala began to be successful, and, under the leadership of Rafael Carrera (president until 1856, and subsequently life-president or dictator), carried the war into Salvador (1863) and regained the controlling position in Central America. Carrera appointed his own successor, and died in 1865. The next significant administration was that of Gen. Justo Rufino Barrios, who was put in office by the Liberals, after their onslaught upon the Jesuits. Barillas was elected to the presidency in 1886. In 1890 and 1891 the progress of the country was checked by epidemics of cholera and smallpox. On 15 March 1892 José Maria Reina Barrios was inaugurated as president, and by a decree of the National Assembly (30 Aug. 1897) his term was extended to 15 March 1902 — in direct violation of the Constitution, which was proclaimed in 1879 and modified in 1885, 1887, and 1889. He was assassinated 8 Feb. 1898 by a British subject of German origin. Dr. Manuel Estrada Cabrera was proclaimed acting president, and received the support of the army. An insurrection begun under Gen. Castillo's leadership 28 July was put down, but only to be quickly followed by another revolutionary movement. Insurgent forces commanded by Morales offered a stubborn resistance in the southwest, until Morales was captured. When peace had been restored, Cabrera was the only candidate for the presidency, and his election was announced 25 Sept. 1898. In the following year the government of Guatemala made a proposition which was equivalent to repudiation of a part of its foreign debt, but yielded to Germany's protest — or threat to use force — and withdrew the discreditable suggestion. Earthquakes which occurred in April 1902 caused great damage in several districts. Amatitlan, Mazatenango, San Marcos, Sololá, and San Felipe suffered severely, and Quezaltenango, in importance the second city of the republic, was totally destroyed. An eruption of the volcano Santa Maria followed on 24 October, and there were outbursts from new

craters in November. Several thousand persons lost their lives through these disasters, and the injury to property (plantations, buildings, machinery, and cattle) has been estimated at $5,000,000 to $10,000,000. Taxes for the relief of the earthquake sufferers were imposed by the Legislative Assembly 24 April 1902. A convention between the United States and Guatemala relating to the tenure and disposition of real and personal property was signed 27 Aug. 1901, and ratifications exchanged at Guatemala 16 Sept. 1902.

Bibliography.— Bancroft (H. H.), 'History of the Pacific States of North America' and 'Native Races'; Bureau of American Republics, 'The Republic of Guatemala' (1897); same, 'Monthly Bulletins' (1902 and 1903); Fröbel, 'Aus Amerika'; Squier, 'The States of Central America'; Vreeland and Bransford, 'Antiquities at Pantaleone,' Smithsonian Inst. Rept. 1884, Pt. I.; Ximenez, 'Las historias del origen de los Indios de Guatemala, traducidos de la lengua Quiché.'

MARRION WILCOX,
Authority on Spanish America.

Guava, gwä'vä, the name of several tropical plants of the myrtle family which yield delicious fruits. The common guava (*Pisidium guava,* or *pyriferum*) is a low bushy tree, bearing long, fragrant white flowers on solitary axillary stalks, from each of which develops a fruit larger than a hen's egg, roundish or pear-shaped, smooth, yellow; the rind thin and brittle; the pulp firm, full of bony seeds, aromatic, and sweet. The jelly or preserve made from it is highly esteemed, and pleasantly mingles tartness with sweetness. The rind is stewed with milk, and is also made into marmalade. This fruit is rather astringent than laxative. Guava buds, boiled with barley and licorice, make a useful astringent drink in diarrhœa. This guava is now naturalized in all the warmer parts of the world, and in many, especially Ceylon, has run wild. Two cultivated varieties are known, the preferable «white,» and the more showy but less agreeable «red.» Several other species are cultivated; as the mountain guava of the West Indies (*P. montanum*) and the marangaba, a dwarf species (*P. pygmæum*) of Brazil, with fruit no larger than gooseberries.

Guaviare, gwä-vē-ä'rā, or **Guayabero,** gwī-ä-bā'rō, a river of Colombia, South America, which rises in the Cordillera Oriental near Bogota, flows eastward for 750 miles, forms the boundary between the departments of Cundinamarca and Cauca, and joins the Orinoco near San Fernando de Otabapo. It is navigable for nearly five hundred miles.

Guayama, gwī-ä'mä, Porto Rico, town in the southeastern part of the department of Guayama; five miles from the sea. Pop. 5,400.

Guayaquil, gwī-ä-kēl', Ecuador, a seaport city, the capital of the province of Guayas, on the river Guayaquil, 25 miles above its mouth in the Gulf of Guayaquil, on the Pacific Ocean. The site is low and unhealthful, but the sanitary conditions have been improved by a modern system of waterworks, and of drainage. Other modern improvements include street railways, gas-lighting, and telephone service, while a railroad connects with the interior. The chief buildings are the custom-house, town-hall, a college, technical school, and the cathedral. Vessels of 18 feet draught reach the town, and the river and its tributary, the Daule, are navigable for smaller vessels, a considerable distance above the town. The export trade averages $6,500,000 annually, cocoa representing nearly five-sixths, the rest being, coffee, ivory-nuts, rubber, hides, and specie. Cottons, hardware, and other manufactured articles are imported. The industrial establishments include steam saw-mills, foundries, machine-shops, ice factories, and a large brewery. The town was founded 25 July 1531 on St. James' day, whence its official title Santiago de Guayaquil. It has had an eventful history, being attacked by pirates, Dutch, French and English, and suffering from disastrous conflagrations, on the last occasion in 1896. Pop. (1903) 55,000.

Guayaquil, a gulf of the Pacific, in the republic of Ecuador. It has a wide entrance, narrowing as it extends inland, and receiving at its head the Guayaquil River. It contains a number of islands.

Guaymas, gwī'mäs, Mexico, city in the state of Sonora; on the Gulf of California, the terminus of the Sonora Railroad, and the chief Pacific port of Mexico. The principal exports are gold, silver, and hides. Pop. 6,100.

Guayrá (gwī-rä') **Falls,** Brazil and Paraguay, a cascade of the Paraná River, on the boundary between the countries mentioned; the result of a contraction of the river-bed from a width of 4,470 yards into a narrow gorge, 65 yards wide, the waters making a plunge of 56 feet. «These falls, situated in the midst of a desolate region, far from human habitation, and rendered almost inaccessible by virgin forests, rapids, and other obstacles, have been visited by very few, though they are said to form one of the grandest spectacles in the world. The volume of water which passes over them is twice that of Niagara.» Consult 'Paraguay' (2d ed. revised by J. S. Decoud, Honorary Corresponding Member of the International Union of American Republics; Washington: Government Printing Office, 1902).

Gubat, goo'bät, Philippines, a pueblo of the province of Sorsogón, Luzon, on the east coast of the Bay of Gubat, 11 miles southeast of the provincial capital Sorsogón. The waters of the bay were formerly infested by pirates, who terrorized the surrounding region. Pop. 13,300.

Gubernatis, Angelo de, än'jā-lō dā goo-bĕr-nä'tēs, Italian Orientalist: b. Turin 7 April 1840. He founded the Italian Asiatic Society in 1886 and has written much in various departments. Among his works are 'The First Twenty Hymns of the Rig-Veda' (1865); 'Death of Cato' (1863), a metrical drama; 'King Nala,' an Indo-Brahmin play; 'Gabriel,' a novel; 'Zoological Mythology' (1872); and 'Dictionnaire International des Ecrivains du Jour.'

Gudgeon, gŭj'ŏn, a small European fresh-water fish (*Gobio fluviatilis*) of the carp family. It swims in shoals, and affords great sport to anglers from its greediness in seizing upon any bait presented. Its name has therefore come to mean a person easily «fooled» to his hurt.

Gudrun, goo-droon', or **Kudrun,** an old German epic, built up out of the popular songs and traditions of the seafaring people who lived

on the shores of the North Sea between the Elbe and the Seine. It was put into permanent form by an unknown poet of Austria in the latter part of the 12th or early 13th century; and ranks second to the 'Nibelungenlied' in the history of early German literature. It relates the history of three generations of the kings of the Hegelings or Frisians, and in the third part tells how Gudrun, the daughter of Hetel, king of the Hegelings, was carried off from her home by Hochmut, son of the king of Normandy, how she preferred to work like the lowest maidservant in the house of Hochmut's mother, and endure the greatest indignities, rather than break her troth pledged to Herwig, king of Zealand, and how finally she was rescued by her brother and her betrothed.

Guebers, gē'bėrz, also **Ghebers, Gabers, Ghavers, Gebirs** (Turkish Ghaur or Ghiaur, infidel, generally but probably wrongly derived from the Arabic káfir), a name applied by Mohammedans to the adherents of the ancient religion of Zoroaster, who reside in Persia. They originally were subjected by the Mohammedans to much cruelty, but are now permitted a great degree of religious freedom. Those who fled to India are known as Parsis (q.v.).

Guelder (gĕl'dėr) **Rose,** or **Snowball,** a cultivated variety of the *Viburnum opulus,* or water elder, of the order *Caprifoliaceæ.* In the European wild form, the inflorescence is a dense cyme whose outer flowers are barren and enlarged, but in the cultivated form all the flowers are neuter and consequently the plant can never set seed. A yellow dye is obtained from it, and the wood is sometimes employed in making tobacco-pipes and other articles.

Guelders, gĕl'dėrz, or **Guelderland.** See GELDERLAND; NETHERLANDS.

Guelfs, gwĕlfs, or **Guelphs,** and **Ghibellines,** names of rival political parties in Italy during the Middle Ages. The words are of German origin, derived respectively from Welf, the name of a princely family in Bavaria (from which is descended the royal Brunswick line and the line of Este), and Waiblingen, the name of a castle in Würtemberg belonging to Conrad of Hohenstaufen, the German emperor. In the great battle of Weinsberg, 1140, the war-cry of the partisans of Conrad was "Hie Waiblingen," that of the adherents of the Duke of Saxony (of the house of Welf) was "Hie Welf." Some years after when the effort was made by the popes and various states and princely houses of Italy, among them the house of Este, to consolidate opposition to the Emperor, the two German words, changed to Guelfo, Guelfi (plus), and Ghibellino, Ghibellini, were adopted as party designations by the Italians. At first and for a long time after the assumption of these names by the great parties in Italy, Guelf and Ghibelline, did really designate two opposing national policies — the policy of the dependence of the several states of the Peninsula on the Empire, and the policy of Italian independence of Germany, and of resistance to imperial absolutism. The states of northern and of central Italy were divided in their allegiance and they were continually passing from one side to the other, but they were predominantly Ghibelline; the states of southern Italy were always Guelf. The popes were the mainstay of the Guelf party and thus were the assertors of the policy of Italian independence and home rule. As usual with party designations, "Guelf" and "Ghibelline" continued in use as the names of factions in no wise concerned with the question of imperialism.

Guell y Rente, Jose, hō-sā' goo-ely' ē rān-tā', Cuban author: b. Havana, Cuba, 14 Sept. 1818; d. Madrid 20 Dec. 1884. He studied law in Havana and Barcelona and practised his profession in his native city. In 1848 he went to Spain where he married Josepha de Bourbon, sister of the king. Besides several novels he published 'Philippe II. et Don Carlos devant l'histoire' (1878), and other works.

Guelph, gwĕlf, Canada, city and county-seat of Wellington County, Ontario; on the river Speed, and on the Grand T. and Canadian P. Rys., 48 miles west of Toronto; founded by John Galt (q.v.). The river affords abundant water power and the city, in a rich agricultural and cattle-raising district, enjoys a large trade. It is an inland port of entry and is the seat of a United States consulate. It has breweries, large flour, saw, and planing-mills, and manufactories of foundry products, machinery, pipe and tubing, musical instruments, sewing-machines, agricultural implements, woolen goods, carpets, furniture, carriages, leather, soap, boots and shoes, etc. Good building stone is quarried in the vicinity. Guelph has in addition to the county buildings, 4 colleges, 16 churches, substantial business blocks, banks, a library and reading-room, and daily and weekly newspapers. The city owns and operates its electric light, gas and power, its water-works and street railway. It is the seat of the Ontario Agricultural College (q.v.) and the Provincial Experimental Farm. Pop. (1901) 11,496; (1904 est.) 12,500.

Guelphs, Order of, frequently styled the **Guelphic Order,** an order of knighthood instituted for the kingdom of Hanover in 1815 by the prince-regent of England and Hanover, afterward George IV. of England, and conferred by the kings of Hanover until the absorption of that kingdom by Prussia in 1866.

Guemal, gwā'mäl, either of two species of small Andean deer (*Cervus chilensis* or *C. antisensis*), whose antlers have only one forking — a long brow-tine projecting straight forward; which have tusks in the upper jaws in both sexes; and whose fawns are not spotted.

Guerber, Helene Adeline, American author. Her books include: 'Empresses of France'; 'Legends of the Middle Ages'; 'Legends of the Rhine'; 'Myths of Greece and Rome'; 'Myths of Northern Lands'; 'Story of the Thirteen Colonies'; 'Story of the Great Republic'; 'Story of the Greeks,' etc., etc.

Guercino da Cento, gwĕr-chē'nō dä chĕn'-tō, Italian painter: b. Cento, duchy of Ferrara, 1590; d. Bologna 1666. His proper name was GIOVANNI FRANCESCO BARBIERI, and he was called Guercino from a squint in his eyes. In 1621, having already acquired renown as a painter, he was invited by Pope Gregory XV. to Rome, but the premature death of this pontiff induced him to return to his native town two years after. About 1642 he went to Bologna, where Count Aldovrandi received him in his palace and entertained him with the most magnificent hospitality. Guercino adopted three different manners of painting, the first in imitation of Caravaggio, which being very dark, he

quitted for that of the Caraccis, and latterly for a style still more light and sketchy; but his middle style is his best. His chief pictures are at Rome. The most celebrated is that of the 'Martyrdom of Saint Petronilla,' which has been copied in mosaic to adorn one of the panels in Saint Peter's between the 'Transfiguration' by Raphael, and the 'Communion of St. Jerome,' by Domenichino. His other chief pictures include a 'St. Anthony' at Padua; an 'Annunciation' at Milan; 'St. Peter' at Modena; 'Cephalus and Procris,' and a scene from the 'Pastor Fido' in the Dresden gallery; the 'Parting of Priam and Hector' at Marseilles. The galleries of Bologna, Florence, and Paris, besides some of those of England and Germany, also possess specimens of this master.

Guereza, gĕr'ĕ-za, or **Guerza,** gĕr'za, (*Colōbus guerza*), an Abyssinian monkey remarkable for its beauty. Short, glossy, jet-black fur covers its limbs, back and head, while a long fringe of silky white hair depends from the flanks. It frequents lofty trees and is much sought for the sake of its valuable fur.

Guérin, Eugénie de, ė-zhā-nē dė gā-răṅ, French writer: b. Cayla, Languedoc, 1805; d. 31 May 1848. She was a sister of G. M. Guérin (q.v.) and much of her life was devoted to taking care of him. Her 'Journals and Letters,' of which an English translation appeared (1865–6), have been widely read in America, both for their charm of style and their devotional spirit. See Parr, 'Maurice and Eugénie de Guérin' (1870).

Guérin, Georges Maurice, zhŏrzh mō-rēs, French poet: b. Languedoc 4 Aug. 1810; d. Paris, 19 July 1839. He was for a time a member of a religious house in Brittany, but in 1833 went to Paris and taught in the Collège Stanislas. His verse has been greatly admired by critical readers. Sainte Beuve in 1860 edited his 'Reliquæ' with critical notice, and the poet forms the subject also of one of Matthew Arnold's 'Essays in Criticism' (1865). See Parr, 'Maurice and Eugénie de Guérin' (1870).

Guernsey, gėrn'zĭ, **Alfred Hudson,** American editor: b. Vermont, 1825; d. 17 Jan. 1902. He was for several years editor of 'Harper's Magazine,' and he was also associate editor of the 'American Cyclopædia' (1872–6). With Henry M. Alden he was author of 'Harper's Pictorial History of the Great Rebellion,' writing the Eastern campaigns (1862–5); and 'The Spanish Armada' (1882).

Guernsey, Egbert, American physician: b. Litchfield, Conn., 8 July 1823; d. Fishkill Landing, N. Y., 19 Sept. 1903. He was graduated from the medical department of New York University in 1846, founded the Brooklyn *Daily Times*, and in 1872 became editor of the 'Medical Times.' He was also president for many years of the Metropolitan Hospital of New York, and published 'Domestic Practice' (1855), which has passed through 11 editions.

Guernsey, the second largest and westernmost of the Channel Islands (q.v.), 46 miles southwest of Cherbourg, France, and 68 miles from Start Point, Devonshire, England. It is triangular in form, nine miles long and from three to four miles broad. The picturesque south coast is lofty and abrupt, the island sloping towards the north which is low and level. Guernsey is noted for its healthful climate, for the fertility of its soil, for its horticultural and floricultural products grown chiefly under glass, and for its magnificent breed of cattle. The chief towns are St. Peter Port (q.v.), the capital, and Saint Sampson, the latter with an important export trade in blue granite. With the adjacent islands of Sark, Alderney, Herm and Jethow, Guernsey forms an autonomous bailiwick. Pop. (1903) 41,000.

Guerrero, Teodoro, tā-ō-dō'rō gĕr-rā'rō, Cuban dramatist: b. Havana 9 Nov. 1824. He was educated in Spain, returning to Cuba in 1845, in which year his first volume of poems, 'Teordorelas,' was published. His comedy, 'La Cabeza y el Corazón' ('The Head and the Heart'), was successfully performed at Havana in 1861, and 'Lecciones do Mundo' ('The Lessons of the World'), didactic verse, reached many editions. The author published other dramas and several works of fiction and was active in Cuban educational affairs.

Guerrero, Mexico, a state bounded by the states of Morelos and Mexico on the north, Puebla on the northeast, Oaxaca on the east and southeast, and by the Pacific Ocean on the southwest. Its area is given as 64,756 square kilometres, or 24,926 square miles. It is mountainous throughout almost its entire extent, the northern section being occupied by the spurs of the ranges of Morelos and Mexico, and the southern by the Sierra Madre del Sur (highest peaks 2,800 metres). Between these two sections runs the Mexcala or Balsas River, to which all the streams of the state are tributary. The principal lakes are Pazahualco, Chantengo, San Marcos, and Nexpa. The Pacific coast line is low and sandy, and has excellent harbors. The bay of Acapulco, the chief port, is deep and spacious. The mineral resources of the state have been as yet very imperfectly developed. Gold, silver, lead, mercury, iron, coal, sulphur, marble, granite, opals, topazes, and diamonds are mentioned among its products. The climate is unhealthy. On the coast the heat (from 95° to 96.80° F.) and rainfall are both excessive; and in the belt above 6,500 feet, the cold is sometimes severe. Fevers, leprosy and affections of the respiratory and digestive organs are the prevailing diseases. The annual value of the agricultural products is about $2,200,000, and the total value of live stock is estimated at $3,000,000. Manufactures are limited to sugar-cane products, mescal wine, palm-oil, cotton fabrics, and leather. Plans for a number of railways have been made, but have not been carried out. There are, however, telegraph and telephone lines, and a few wagon roads. Steamers of the Pacific Mail and the Mexican International Company touch at Acapulco. The state is divided into 14 districts: La Unión, Mina, Alarcón, Hidalgo, Alvarez, Zaragoza, Morelos, Abasolo, Allende, Tabares (chief town Acapulco de Juarez, with population of 5,780), Galeana, Chilpancingo (principal town and capital of the state Chilpancingo de los Bravos, with population of 6,321), and Guerrero. Total population of the state 420,336.

Guerrilla, gė-rĭl'la, an irregular mode of carrying on war by means of small independent bands of armed men, self-constituted and un-

connected with the regular army. The name originated in the Spanish war for independence (1808–14), when the term guerrillas was applied to the bands of Spanish peasants, organized to harass the French armies that then occupied Spain. Guerrilla warfare was carried on to some extent during the Revolution and also in the Civil War, particularly by the Confederates. Guerrilla methods were also effectively used by the Cuban patriots in Cuba's war for independence.

Guesclin, Bertrand du. See Du Guesclin.

Guest-bees, a large genus (*Nomada*) of little bees of both Europe and America, which lay their eggs in the nests of burrowing bees of the genera *Andrena* and *Halictus,* where the young share the food gathered for the young of their hosts, and the adults live harmoniously together,— apparently a case of partnership rather than of parasitism. Compare Cuckoo-Bee.

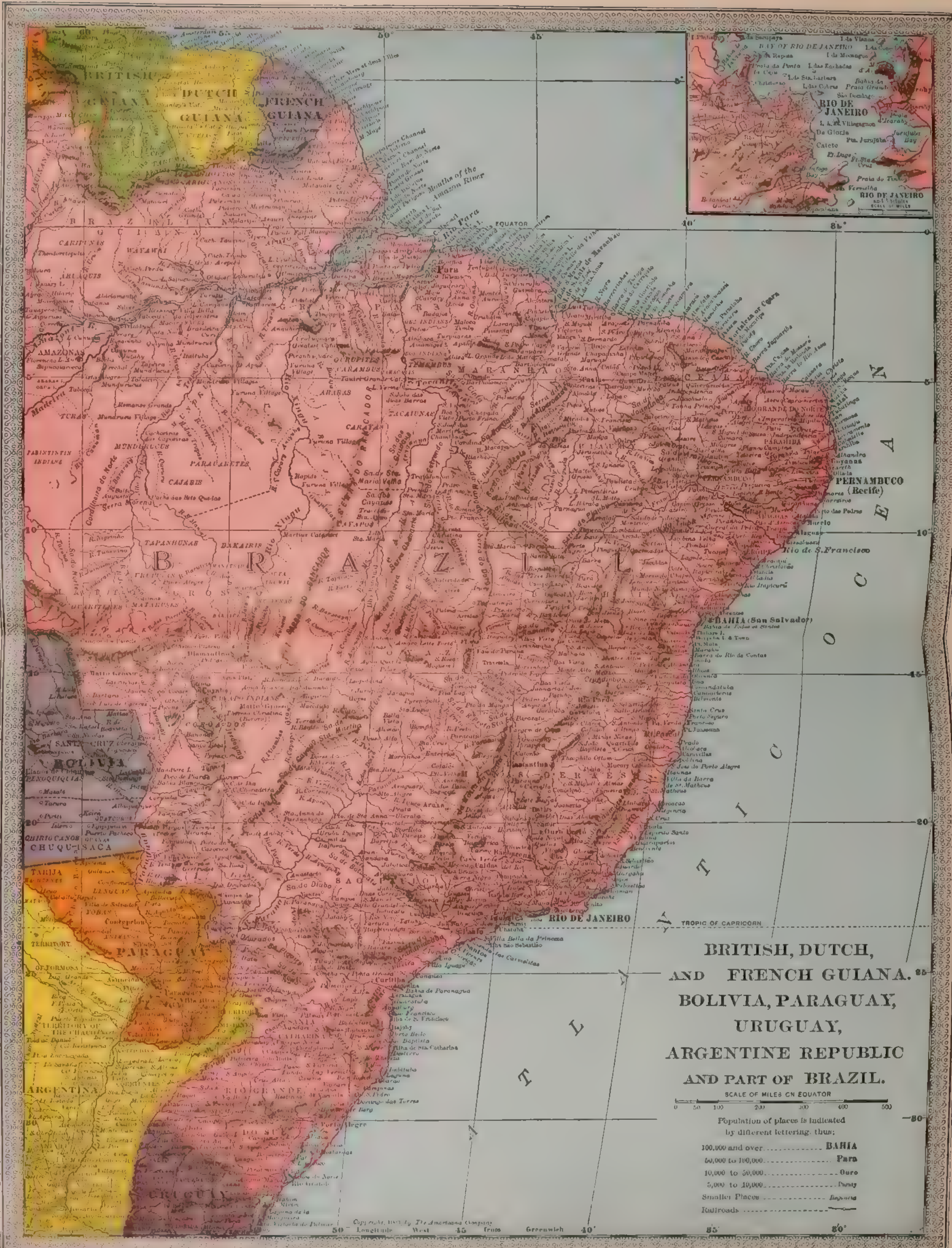
Gug'genheimer, Randolph, American lawyer and politician: b. Lynchburg, Va., 20 July 1848. He studied at New York University and began his business career as clerk in a woolen goods house in New York. He later entered a law office, studied law, was admitted to the bar, and became the head of a law firm, which has been particularly successful in important negotiations with English syndicates, investing capital in American industries. He has also been active in the political life of the city as a Democrat; was a member of the board of education for three years; and was also president of the board of aldermen, in which capacity he served as acting mayor of Greater New York.

Guiana, ge-ä'nä, the name applied to all that tract of country in South America bounded by the Atlantic Ocean, the Amazon River and its branches, and the Orinoco River and its branches. It lies between lat. 8° 40' N. and lat. 3° 30' S., between lon. 50° and 60° W. Its greatest extent east and west is 1,090 miles; its greatest breadth, from Punta Barima, to the confluence of Rio Negro with the Amazon, is 710 miles. The total area is more than 800,000 square miles. The western districts belong to Venezuela; the southern and eastern districts to Brazil. The three European colonies, the British, Dutch, and French Guianas, extend from the seacoast to the frontiers of those republics.

Early voyages to this part of South America are mentioned in the article Discoveries, etc. The first settlements on the northern coast lay much farther toward the west, and exploration and colonization east of the Orinoco began when European adventurers continued in this new field their search for Eldorado. Spanish and Portuguese expeditions into Guiana during the 16th century were very numerous, but always disastrous. The English undertook its conquest, believing, in the words of Sir Walter Raleigh, "that whatever prince shall possess it, that prince shall be lord of more gold, and of a more beautiful empire, and of more cities and people, than either the king of Spain or the great Turk." Capt. Laurens Keymis, sent by Raleigh in 1596 to explore the region, reported that "the like occasion seldom happeneth in many ages." In the articles, Dabaiba and Eldorado, it is shown that the birthplace of the Eldorado myth was the region now known as Colombia, and that the time of its birth was near the beginning of the 16th century; but in the course of 100 years the site of Eldorado was transferred to central Guiana, and Schomburgk asserts that the possibility of its existence in that locality continued to occupy the imagination and attention of adventurers until the close of the 18th century. Humboldt was the first to prove that a lake "like unto Mare Caspium," as Raleigh described it, no longer existed, and it was erased from the maps; Schomburgk identified the locality where it was sought with the small lake Amucu near an Indian village named Pirara. Raleigh led several armaments from England with the hope of conquering the golden capital. When these undertakings ended in disappointment, Capt. Keymis committed suicide, and Raleigh "paid the forfeit of his illusions with his life upon the scaffold." Dutch traders, who arrived about 1580, settled on the Pomeroon and Essequibo rivers; and after the establishment of the Dutch West India Company land on the Berbice River was granted to van Peere. The Pomeroon colony was abandoned owing to attacks by the English in 1666 and by French privateers. In 1740 English planters from the West Indies established themselves on the Essequibo, as a result of the "open door" policy adopted by the Dutch with respect to that region alone. Next, the overflow of immigration settled in the Demerara district; and in 1781 all three colonies, Essequibo, Demerara, and Berbice, were taken by the British. Recaptured before the year was out by the French (who were then allies of the Netherlands), they were again taken by the British in 1796. The peace of Amiens restored the original status; but English troops interposed once more, and the colonies were ceded to Great Britain by the treaties of 1814–15. They were united in 1831, forming British Guiana.

In the region east of Berbice, a few English people attempted to form a colony at the village of Paramaribo (1626), but abandoned the project. Ten years afterward the French invested Paramaribo, but relinquished it, proceeded to Cayenne, and there founded what is now known as French Guiana. In 1652 a body of English settlers again arrived at the Coma River, and succeeded in establishing themselves. This colony was granted in 1662 by Charles II. to Lord Willoughby, who changed the name Coma River into Surryham, in honor of the Earl of Surrey. Hence we have "Surinam," the name often used instead of Dutch Guiana. The British crown bought the colony from the heirs of Lord Willoughby, but it passed into the hands of the Dutch about the time when Holland gave up the attempt to keep New Amsterdam, now New York. The statement often repeated, that Surinam was "exchanged" for New Amsterdam is incorrect.

1. British Guiana is situated approximately between lat. 1° and 8° 40' N. It is bounded on the north and northeast by the Atlantic Ocean, on the east by Dutch Guiana, on the south by Brazil, and on the west by Brazil and Venezuela. Its area is 104,000 square miles. The old settlements of Essequibo, Berbice, and Demerara form counties with the same names. Of these, Demerara contains the capital of the colony (see Georgetown); Essequibo, the town


BRITISH, DUTCH, AND FRENCH GUIANA.
BOLIVIA, PARAGUAY,
URUGUAY,
ARGENTINE REPUBLIC
AND PART OF BRAZIL.
SCALE OF MILES ON EQUATOR
0 50 100 200 300 400 500
Population of places is indicated by different lettering, thus;
100,000 and over BAHIA
50,000 to 100,000 Para
10,000 to 50,000 Ouro
5,000 to 10,000 Pesty
Smaller Places
Railroads
Longitude West from Greenwich
BRITISH GUIANA
DUTCH GUIANA
FRENCH GUIANA
BRAZIL
BOLIVIA
PARAGUAY
ARGENTINA
URUGUAY
AMAZONAS
PERNAMBUCO (Recife)
BAHIA (San Salvador)
RIO DE JANEIRO
TROPIC OF CAPRICORN
EQUATOR
Mouths of the Amazon River
Rio de S. Francisco
ATLANTIC OCEAN
RIO DE JANEIRO
BAY OF RIO DE JANEIRO

of Bartica, the point of departure for miners going to the gold-fields; and the capital of Berbice County is New Amsterdam. One of the chief points on the new boundary line with Venezuela, Mount Roraima, is an immense sandstone mass rising with perpendicular sides 2,000 feet above the slopes (themselves 6,000 feet above sea-level) which form its base. Some of the neighboring mountains resemble it in form, but are less imposing. Midway between this group and the Atlantic coast is the Imataca range, extending east-southeast to the confluence of the Cuyuni and Essequibo. The latter with its tributaries drains nearly the whole interior of the colony; the Demerara, though much smaller, is more important, because it flows through the region which has become the centre of population; the Corentyne is the boundary between British and Dutch Guiana.

Geology and Mineral Resources.— The original sea beach is found far inland, where it now appears as long stretches of white sand reefs, the sand being derived from a barrier of primary, volcanic and metamorphic rocks, which impedes the navigation of the rivers. The strip between this barrier and the ocean front — composed of layers of soft mud, clay, sand, broken shells, and decomposed vegetable matter — is really an enormous mud-flat, about 100 feet in depth, and covered with a rich, heavy loam, and in places, with a kind of peat called pegass. The whole interior of the country, between the agricultural coast-strip and the range culminating in Roraima, is an auriferous region. The gold is commonly found in combination with silver. Quartz-mines have been worked in upper Demerara, but placer-mines in the beds of former streams or the channels of existing ones are more usual. Other mineral products are iron, sapphires, diamonds, mercury, garnets, antimony, and plumbago. A sandstone formation characterizes the southwest, from Mount Roraima to the Potaro and Essequibo rivers, thence extending eastward across the Demerara, Berbice, and Corentyne. The sandstone is interbedded with volcanic rocks. In many parts of the colony there are red, yellow, and blue clays; and fine white clay, suitable for the manufacture of porcelain, is also found.

Soil and Climate.— The surface of the coast alluvium is so fertile that alternation of crops is not required; it is, however, very heavy and hard to cultivate. The thermometer ranges generally from 76° to 86° F., with little difference in this respect between day and night. Rainfall in some years 130 inches, in others not more than 70 inches. The year is divided into two rainy seasons (November–February and May–July), and two dry seasons. Neither destructive earthquakes nor hurricanes occur. There has been only one serious outbreak of yellow fever during 50 years. Death rate of the colony about 35 per 1,000.

Flora and Fauna.— Characteristic forest products are exceedingly hard and heavy woods. The greenheart, mora, and wallaba are valuable for building; the simaruba, letter-wood, and crabwood, for making furniture, etc. Vegetation in Guiana is remarkable on account of the altitude of the trees and the great size of leaves and flowers. The gigantic water-lily, Victoria Regia, is very common. Some of the orchids form large masses, with flower-stems 12 feet high. Common mammals are sloths, deer, ant-eaters, tapirs, armadillos, peccaries, jaguars, cavies, and ring-tail monkeys. Monkeys belong to two families which are entirely confined to this region, and bats develop here their most extraordinary specializations. In some parts of the forest vampires are "ready to suck the foot or even the cheek of the unwary traveler." The manatee (*vulgo* "mermaid" or "water-mamma"), inhabiting some of the large rivers, and coming to the surface at intervals to breathe or to graze on the plants which line the banks, owes its popular designations to the circumstance that it suckles its young at the breast. The representative families of birds are, with few exceptions, peculiar to this region, the list of such birds including greenlets, tanagers, hang-nests, sugar-birds, tree-creepers, manakins, and cotingas. Alligators and boa constrictors both attain to great size in this region; iguanas and smaller kinds of lizards are numerous. Among the insects, the variety of genera and species can, it is thought, scarcely be equaled in any other part of the world. Uncommon brilliance of coloring is characteristic of both the birds and the insects.

Agriculture.— About 80,000 acres are under cultivation, or, say, one acre out of every 100 available for the purpose; and of this amount 71,766 acres are in sugar plantations. Only a very small portion is devoted to coffee and cocoa.

Commerce, Shipping, Railways, etc.— The chief imports in 1901–2 were tissues, flour, machinery, manures, rice, fish, hardware, coal, and tobacco, cigars, and cigarettes. The total value of imports (principally from Great Britain and British possessions) was $7,073,845. The chief exports in the same year, with their values: Sugar, $5,190,815; gold, $1,857,460; rum, $804,230; balatta, $118,265; timber and woods, $105,605; diamonds, $95,275; charcoal, $35,930; and molasses, $24,015. The total value of exports was $9,168,120. In 1901 the registered vessels belonging to British Guiana numbered 48, comprising 32 sailing vessels (1,497 tons), and 16 steamers (2,213 tons). Total tonnage entered and cleared, in 1901–2, was 725,867. (See also routes of vessels under GEORGETOWN.) There are 108 miles of railways, 264 miles of good roads, and 12 miles of the larger sort of canals, used for navigation. Smaller canals, to carry off superfluous water from the plantations, intersect each other in every direction. The heavy rainfall and the flatness of the coast region oblige the planters to maintain these canals to provide drainage, and by means of the larger draining trenches the sugarcanes are taken to the mills in punts. There are 73 post-offices, 46 telegraph offices, 9 traveling post-offices, about 559 miles of telegraphs and cables, and telephone services (677 miles) in Georgetown and New Amsterdam.

Money and Banking.— British gold and silver are used. There are 25 savings banks, with 21,266 depositors, and 2 banks with note circulation.

Government.— The governor is assisted in executive and administrative matters by an advisory council, composed of 3 colonists and 3 officials, all appointed by the king of England; in legislative matters by the Court of Policy (7 officials beside the governor, and 8 elective members, chosen from inhabitants by constituency of 2,676 voters qualified by income or property). The governor has a casting vote, and can decide

any question against the votes of the representative members. The colonists are in the majority, however, in the Combined Court, which votes the taxes and public expenditures.

Finances.— Total revenue for the year 1901–2 was $2,657,535, derived mainly from customs, licenses, duty on rum, and royalty on gold. Public expenditures in the same year amounted to $2,613,155. The public debt in 1901 was $4,960,600.

Population, Schools and Judiciary.— The census of 1891 showed: Negroes, 115,588; East Indians (Hindu coolies), 105,465; aboriginal Indians, about 17,463; Portuguese from Madeira, 12,166; whites of other nationalities, 4,558; Chinese, 3,433; mixed races, etc., 29,376. The total number of inhabitants was therefore 288,049. In 1901–2 the schools, numbering 213, had 26,684 pupils. There are three judges, and, in the several districts, a number of magistrates. The criminal law is based on that of England; in civil cases the Roman-Dutch law is applied, with certain modifications.

History (including the boundary dispute with Venezuela).— Prohibition of the slave trade checked the agricultural development of the colony, and emancipation of the slaves (1838) ruined many planters, the freed negroes demanding higher wages than the planters could afford to pay. This crisis led to the introduction of large numbers of laborers from Madeira, the East Indies, China, and Malta. Immigrants of a different class began to arrive about 1886 in consequence of the rediscovery of gold; but serious difficulties arose precisely on account of the enhancement in the value of the auriferous regions, some of the most promising of which were located in the territory west of the Essequibo claimed by both Venezuela and Great Britain. The inland limits of the Spanish (afterward Venezuelan), the British, the Dutch, the French, and the Portuguese (afterward Brazilian) Guianas were undetermined. In 1841 Schomburgk surveyed the boundary line of British Guiana for the British government, and made two maps; the second or revised map placing the boundary with Venezuela much farther toward the west than the first. Subsequently Venezuela and Great Britain agreed not to encroach upon the territory in dispute, pending a settlement of the boundary question, but both countries offended against the spirit of this compact. The proposal for arbitration in 1887 was met by England's prompt refusal to admit any doubt as to her title to the lands east of the revised Schomburgk line, and, a little later, by the establishment of British posts, and the declaration that the region drained by the Barima River was hers by right. It is necessary to bear in mind that if England had accepted the views of Venezuela and Brazil as to the boundaries of British Guiana, that colony would have disappeared from the map. Brazil claimed all but about 12,000 square miles; Venezuela nearly the whole of the old Essequibo colony, the Pomeroon and the unsettled interior districts. When President Cleveland, in 1895, called to the attention of the British government the bearing of the Monroe doctrine upon the question at issue, his suggestion was at first not accepted. His message to Congress went much farther. It advised Congress that a commission should be appointed for the determination of the true boundary, and declared in effect that any attempt to extend British territory beyond the true boundary should be resisted by the United States, by force, if necessary. It was a threat of war. Pursuant to the act of Congress 21 Dec. 1895, a commission was appointed 1 Jan. 1896. But before their report was submitted a treaty providing for the reference of the matter to a tribunal of arbitration had been signed at Washington (2 Feb. 1897). Arbitrators were: Chief Justice Fuller and Justice Brewer of United States Supreme Court; Lord Herschell (and, after his death, Lord Russell of Killowen), and Justice Sir R. H. Collins; and as president, Prof. Martens. The tribunal met at Paris in 1899. The award, given 3 October, determined the boundary nearly in correspondence with the second or revised Schomburgk line, assigning to Great Britain a region about 60,000 square miles in area which Venezuela had claimed. On the other hand, Point Barima, at the principal mouth of the Orinoco, and certain gold-fields near the headwaters of the Cuyuni, were awarded to Venezuela. The territory of British Guiana, thus defined, extends along the seacoast to Point Playa, and includes the whole valley of the Barima and that of the Cuyuni east of the Wenamu — the larger part, though not the best part, of the mining region.

2. Dutch Guiana or Surinam is bounded on the north by the Atlantic Ocean, on the east by French Guiana, on the south by Brazil, and on the west by British Guiana. It extends from lat. 2° to 6° N., and from lon. 53° 50′ to 58° 20′ E. Area 46,060 square miles. The political divisions are districts, 16 in number, and communes; the capital, Paramaribo, has about 31,817 inhabitants. Chief products are: Cacao (75 plantations), sugar (7 plantations), coffee, bananas, rice, maize, rum, molasses, and gold (output valued at about $480,000 in 1900). The mining experience of this colony resembles that of British Guiana: the metal has been sought hitherto in beds of streams, etc., but is now being taken also from mines which require crushing machinery. Imports regularly exceed in value the exports; thus in 1901 imports amounted to $2,831,112, and exports to $2,146,224. During the years 1897 to 1901 the value of exports remained almost stationary, while that of imports steadily increased. Executive authority is vested in a governor. The representative assembly, called the Colonial States, is composed of members chosen for 6 years by a limited number of electors. The council consists of 5 members, including the governor himself as president, and represents the sovereign. The revenues of the colony fall short of the expenditures. The military force is about as follows: Garrison, 20 officers and 351 men; militia, 27 officers and 411 men; and civic guard, 59 officers and 1,061 men. There are a few guard ships and vessels of the royal navy. The number of inhabitants in 1902 was somewhat more than 69,000. Educational institutions are: A normal school; schools maintained by the Moravian Brethren and the Roman Catholics; 33 private schools, with 4,822 pupils; and 20 public schools, with 2,342 pupils. The judicial system comprises a court of justice (all the officers appointed by the queen), two circuit, and three district courts. Slavery was abolished 1 July 1863, but the authorities imposed the con-

ditions that for 10 years the emancipated negroes should remain upon the plantations of the districts in which they had formerly lived, and should perform the same kind of work for wages that they had been accustomed to while in bondage. After 1 July 1873, the importation of laborers to replace the freedmen became a matter of life and death in Surinam as in the neighboring colonies, for agriculture was almost ruined.

3. French Guiana, lying between the Atlantic Ocean, Brazil, and Dutch Guiana, has an area of about 30,500 square miles. Besides Cayenne, capital of the colony, and its only port (population, according to the latest census, 12,612), there are 13 communes. Mineral productions are gold, silver, marble, phosphates, and iron. In 1901 the exports of gold amounted to 94,147 ounces. Agricultural productions are varied (including sugarcane, cocoa, coffee, rice, indigo, tobacco, maize, and manioc), but laborers are few, the area under cultivation is small, and the total value of the crops insignificant. Here, as in Dutch Guiana, the value of exports is much less than that of the imports, the difference in 1901 being about $689,750. Colonial interests are entrusted to a governor and privy council of 7 members, and one deputy represents the colony in the French Parliament. There is also an assembly called the Council-General, composed of 16 members. Revenue and expenditures for 1902 were each estimated at $657,261; but the cost of maintaining the penal establishment ($1,139,122, according to the budget of 1903), is borne by the French republic. Between 300 and 400 French soldiers are kept in the colony. The total population, including convicts and Indians, was given as 32,908 in 1901. Cayenne has a superior court, court of first instance, and two justices of the peace; a college, a library, and a museum; in the entire colony there are 27 primary schools

From the first, the French undertaking in Guiana has been unsuccessful. On 11 Dec. 1653, the survivors of the original colony abandoned the fort and sailed away, after suffering from hunger and disease. A new company formed for the colonization of Cayenne in 1663 was scarcely able to hold its own against hostile neighbors in Brazil. The deportation of political prisoners to Guiana at the end of the 18th century completed the ruin which Portuguese attacks had begun; for the exiles ascribed the death of their companions to the climate; and French Guiana was completely discredited in the eyes of the world. In January 1809, the colony surrendered to the Portuguese and English. It was restored to France by the treaties of 1814–15. Since 1855 it has been used as a penal settlement. In 1902 the number of convicts in residence there was 10,075, including 240 women. The boundaries with Brazil were determined 1 Dec. 1900, by the Swiss court of arbitration.

Bibliography.— Dalton, ‘History of British Guiana’; Kappler, ‘Holländisch-Guiana’; Raleigh, ‘Newes of Sr. Walter Rauleigh, with the true description of Guiana’ (1618); Rodway, ‘Hand-book of British Guiana’; Schomburgk, ‘Twelve Views in the Interior of Guiana, with Descriptive Letter-press’; Ternaux-Compans, ‘Notice historique sur la Guyane française.’

Marrion Wilcox,
Authority on Spanish America.

Guicciardini, Francesco, frän-chěs′kō gwē-chär-dē′nē, Italian historian: b. Florence 6 March 1483; d. there 23 May 1540. He studied at Padua, and became an advocate and professor of law at Florence. In 1512 he was appointed ambassador to the court of Ferdinand the Catholic of Spain. At a later period he was invited by Leo X. to his court, and entrusted with the government of Modena and Reggio. This office he discharged also under Adrian VI., to the general satisfaction; and afterward, when Clement VII. (de' Medici) ascended the papal chair, Guicciardini was sent as lieutenant of the pope to Romagna. He contributed here to the public good by restoring civil order, constructing roads, erecting public buildings, and founding useful institutions. Having been appointed lieutenant-general of the pope, he, in 1521, defended Parma when besieged by the French. In 1534 he began his great work ‘Istoria d'Italia’ (1561-4) extending from 1490 to 1534. In 1537 he contributed greatly to the elevation of Cosmo de Medici to the office of grand-duke, but when later he attempted to impose constitutional limitations upon the grand-ducal power, he lost his influence. The ‘History’ was translated into English by Goddard, and the translation published between 1753 and 1761. The reader of Guicciardini is sometimes offended by a want of method, and his statements cannot always be depended on as derived from the best sources.

Guide-birds, or **Honey-guides,** certain small, mainly black and yellow birds, allied to the barbets, and constituting a genus inhabiting the tropical regions of the Old World, which have the curious habit of attracting the attention of men, and of honey-loving quadrupeds, to bees' nests, profiting by the disturbance which follows. They are fond of bees, grubs, and honey, but cannot often get them without assistance; sometimes, also, they show equal zeal in leading a person to a snake, leopard, or something else which has attracted their notice. Although the genus is known in India and Malaya, it is in South Africa that its traits are most noticeable and the books of travelers and explorers there abound in accounts of its guiding habits. Sir John Kirk contributed the following exact description of the work of *Indicator minor* to the ‘Ibis’ (1864):

“The honey-guide is found in forests, and often far from water, even during the dry season. On observing a man it comes fluttering from branch to branch in the neighboring trees, calling attention. If this be responded to, as the natives do by whistling and starting to their feet, the bird will go in a certain direction and remain at a little distance, hopping from one tree to another. On being followed it goes further; and so it will guide the way to a nest of bees. When this is reached, it flies about, but no longer guides; and then some knowledge is needed to discover the nest, even when pointed out to within a few trees. I have known this bird, if the man after taking up the direction for a little then turns away, to come back and offer to point out another nest in a different part. But if it do not know of two nests, it will remain behind. The difficulty is, that it will point to tame bees in a bark-hive as readily as to those

in the forest. This is natural, as the bee is the same; the bark-hive, ‘musinga’ as it is named, being simply fastened up in a tree and left for the bees to come to. The object the bird has in view is clearly the young bees. It will guide to nests having no honey, and seems equally delighted if the comb containing the grub be torn out when it is seen pecking at it.”

Guido Reni. See Reni, Guido.

Guido Aretino. See Aretino, Guido.

Guidon, gī'dŏn, a swallow-tailed flag, such as is carried by a regiment of cavalry or mounted artillery. In the United States cavalry the regimental guidon is half red and half white, dividing at the fork. The red above has “U. S.” in white. The white is below, and has the letter of the company in red. The fly is 3 feet 5 inches to the end of the tail; the head is 27 inches. The lance is 9 feet long, including spear and ferrule.

Guienne, gē-ĕn', or **Guyenne,** ancient Aquitania (q.v.), a former southwestern province of France, now divided into the departments of Gironde, Lot, Lot-et-Garonne, Dordogne, Aveyron, and part of Landes and of Tarn-et-Garonne. The capital was Bordeaux.

Guija, gwē'hä, a lake in the republics of Guatemala and San Salvador, in Central America. It is in a volcanic region, and contains two small volcanic islands.

Guikowar, gīk'wär, the native title of the Mahratta prince, ruler of the province of Baroda (q.v.) in British India. The ruling Guikowar in 1874 was tried for attempting to poison the British resident and was deposed. Since 1802, when the province lost its independence to the English, the authority of the Guikowar has been merely nominal.

Guild, Curtis, American journalist: b. Boston, Mass., 1827. After several years devoted to reporting for the Boston *Journal,* he became one of the owners of the Boston *Traveller* and in 1859 established the Boston *Daily Commercial Bulletin,* of which he became the editor. He has published ‘Over the Ocean’ (1867); ‘Aboard Again’ (1873); ‘Britons and Muscovites’ (1888); ‘A Chat About Celebrities’; ‘From Sunrise to Sunset’ (verse).

Guild, Curtis Jr., American journalist and politician: b. Boston, Mass., 2 Feb. 1860. He was graduated at Harvard in 1881 as class orator, and entered the employ of the *Commercial Bulletin* of Boston, conducted by his father, Curtis Guild (q.v.). He interested himself at once in local politics, was Republican delegate-at-large to the St. Louis convention in 1896; and active in securing the gold plank in the national platform. In the following campaign he made a political tour of 10 States. He was appointed brigadier-general of Massachusetts militia and inspector-general of rifle practice by Gov. Roger Wolcott. At the outbreak of the Spanish war he was appointed lieutenant-colonel and inspector-general, United States Army, serving in the Seventh Army corps under Gen. Fitzhugh Lee. In 1900 he accompanied Gov. (now President) Roosevelt on a tour of political speaking through the West. In 1902 he became sole owner of the *Commercial Bulletin.* He was elected, 4 Nov. 1902, lieutenant-governor of Massachusetts, with John L. Bates, governor-elect; and was inaugurated 10 Jan. 1903. In 1905 he was elected to the governorship.

Guild, Reuben Aldridge, American librarian and author: b. West Dedham, Mass., 4 May 1822; d. 1899. His published works include: ‘Biographical Introduction to the Writings of Roger Williams’ (1866); ‘History of Brown University with Illustrative Documents’ (1867); ‘Chaplain Smith and the Baptists’ (1885).

Guild, a fraternity, society or company, formerly active in commerce and mechanics. Guilds played an important part in public affairs in the Middle Ages. The Romans had various mechanical fraternities, but these seem to have been merely religious and political societies; while the associations of workmen in the arsenals that existed under the empire were regular hereditary castes, enjoying certain privileges and bound to certain duties. In Italy, the cradle of the class of free citizens in the Middle Ages, and particularly in the Lombard cities, those connecting links between the ancient and modern civilization, some remains of these Roman institutions, or recollections of them, probably contributed to revive the guilds, which naturally presented themselves as an excellent means of supporting the citizens against the nobility by uniting them into powerful bodies. It is certain that small societies existed as early as the 12th century, which appear, in the following century, to have been in the possession of important political privileges. When the advantages of these associations became known and felt they rapidly increased; and in the struggles of the citizens and the nobility the principal resistance against the latter was made by the corporations. As soon as the citizens acquired an influence on the administration the guilds became the basis of the municipal constitutions, and every one who wished to participate in the municipal government was obliged to become the member of a guild. Guilds in Germany possessed no political importance before the 13th century. At this time they acquired the right of bearing arms for the defense of their own interests, and when a struggle arose between them and the citizens belonging to ancient families the guilds were victorious, and became so powerful that even persons of “free occupations” joined these associations as the allodial possessors of land sometimes placed themselves under feudal lords. The by-laws of the German guilds contained regulations as to the training of apprentices, the practice of one's trade in different towns as a journeyman, and the requirements of a master. At an early period these workmen's associations met with opposition, but the opposition was not at first directed against them on account of the obstacles they threw in the way of commercial intercourse, and the other evil consequences of their monopoly, but simply on account of their political influence. In the 18th century several edicts were made in Germany against the abuses of the guilds, and at different dates in the 19th century freedom was granted in most of the states of Germany to all to practise any trade without being admitted into a guild. In Austria this was done in 1860, and

1. Guide-bird (Indicator sparrmanni).
2. Garden Warblers (Sylvia curruca and S. rufa).
3. Guinea Hens (Numida cristata and N. meleagris).
4. European Golden Oriole (Oriolus galbula).
5. Grakle (Eulabes religiosa).

in 1868 it was done for all the states of the North German Confederation.

In Great Britain the societies of mechanics were important principally in a political respect, on account of their connection with the democratic element of the constitution. These societies originated at the time of the development of the importance of the cities. In the towns where they long existed they had an important influence in the election of representatives, and in the municipal administration. These guilds, in England, had no legal right to prevent any man from exercising what trade he pleased. The only restriction on the exercise of trades was the statute of Elizabeth, requiring seven years' apprenticeship. The guilds of the city of London (among the oldest of which are the weavers, founded in 1164; the parish clerks, in 1232; the saddlers, in 1280; the fishmongers, in 1284; the goldsmiths, in 1327; the skinners, in 1327; and the grocers, in 1345) are still very important corporations, still continuing to fulfil the chief object for which they were founded — that of giving relief to poor and decayed members, and also having in many cases the management of vast funds bequeathed for benevolent purposes by persons who selected one or other of the guilds as trustees. Sometimes these funds are bequeathed for specific purposes, which the guilds, as trustees, are of course bound to carry out; but in other cases, where they are available for general purposes, the guilds have usually shown great discretion in the manner in which they have employed them. Besides the secular guilds or mechanics' associations there were from a very early period, in Great Britain, religious guilds, resembling the religious societies of modern times. From the time of Henry II. all such guilds were required to have a charter from the crown. In 1388 a return to these guilds was ordered to be made, and it was then found that that of Corpus Christi, York, numbered 14,800 members. Some of the most objectionable features of the ancient guilds have again been developed by some of the trades unions, their modern representatives.

In France guild-privileges were sold by the state from the 10th century till the revolution of 1789, and the position of the artisan had come to be a most pitiable one; but at that date every restriction on the exercise of any trade was removed. This was done also at a later period in Belgium, Holland, Italy, Sweden (1846), and Denmark (1862). An account of guilds in America will be found under LABOR UNIONS. See also TRADE UNIONS for the modern European history of guilds.

Guildhall, the usual designation in England for the mediæval city halls, the most famous of which is the London Guildhall, King Street Cheapside, first built in 1411, all but destroyed in the fire of 1666, and rebuilt in 1669. The façade dates from 1789. The great hall used for the famous city feasts, the election of city officers and members of Parliament, and for the public meetings of the livery and freemen, is 153 feet long, 48 feet broad, and 55 feet high. It is decorated by statues of various celebrities, and in the common council room there is a collection of valuable paintings.

Guilford, Conn., a town and borough of New Haven County, on Long Island Sound, and on the New York, N. H. & H. R.R., 14 miles east of New Haven. It was settled as Menunkatuck by English colonists in 1639, and one of the ancient stone buildings of that date is now used as a State museum. Farming, canning, iron working, and some woolen manufactures are the chief industries. Halleck the poet was a native and resident of Guilford. Pop. of town and borough (1900) 2,785; of town, 1,512.

Guilford (gĭl'fŏrd) **College,** N. C., a town of Guilford County, on a branch of the Southern R.R., six miles west of Greensboro. It was incorporated in 1895 and derives its name from Guilford College, a coeducational establishment controlled by the Friends, and founded in 1837. The income of the college is $20,000, and it has a library of over 6,000 volumes.

Guilford Court House, Battle of, 15 March 1781; in results one of the decisive battles of the Revolution. Cornwallis at Hillsboro proclaimed that he had conquered North Carolina, and called on the well-disposed to rally around him; Greene, awaiting reinforcements near the Virginia border, perceived the necessity of showing the patriots they were not abandoned, and advanced across the Dan. After some days of fencing and recruiting, Greene halted for battle at Guilford Court House. He had about 4,400 men, but 3,000 were militia; and of his Continental regulars, only the Virginians and the First Maryland were veterans, the Second being new. Cornwallis had 2,213 trained troops. Greene posted his first militia line in an open field, to thin the British front before giving way; the second in a wood 300 yards back; the regulars on a rise 400 yards to the rear, near the court-house. Their front was convex: the Virginians on the right, then in succession Singleton's artillery, Gunby and Howard's First Maryland, and Ford's Second Maryland on the left. Lee's Legion and Campbell's riflemen guarded the left flank; William Washington's cavalry, Lynch's rifles, and the remnant of the Delaware regiment, the right flank. The British routed the first militia after it fired one or two volleys; but only drove the second from the wood after an obstinate and murderous combat. Advancing against the hill, their left was riddled by a withering fire, and then broken by a bayonet charge of the First Maryland; but their right crushed the Second and captured two cannon. The First faced about and checked it; Washington in turn pierced the British line and retook the pieces. The First steadily crowded back their opponents with the bayonet; and Cornwallis only stayed the tide of defeat by ordering his artillery to open on the Marylanders through his own ranks, checking the pursuit at heavy loss to himself. Reforming, the British moved forward; and with double the number of real troops, carried the hill and held it against every assault. Toward evening Greene, after five hours' conflict, withdrew, leaving his artillery on the field because the horses were killed. The American loss was 79 killed and 184 wounded; and about 1,000 militia dispersed to their homes. Cornwallis lost 93 killed, 413 wounded, and 26 missing — 532 in all, or a quarter of his entire force. He announced a victory to Parliament, but Fox declared that "another such victory would destroy the British army"; and, in fact, Cornwallis had to fall back on Wilmington, abandoning his hold on the

Carolinas, except two or three places on the coast, and shortly going to Virginia and capture.

Guillaume, gwĭ-yōm', **Eugene,** French sculptor: b. Montbard, France, 4 July 1822; d. Rome, Italy, 28 Feb. 1905. He opened his first studio at Dijon, and subsequently became a pupil of Pradier at Paris. In 1845 he carried off the Grand Prix de Rome. It was during studies at Rome that he manifested that mastery of the human form which appears in his 'Reaper,' which he modeled at Rome. It was subsequently cast in bronze, and is now in the Luxembourg. In 1852 he produced in marble the sitting figure of Anacreon with the dove of Venus. He was, however, less successful in ideal creations than in portrait busts. His statues of Napoleon I. as lieutenant of artillery and as emperor, his bust portraits of Archbishop Darboy, of F. Baloz, Ferry, and Thiers are characteristic and dignified, but he is perhaps best known for his sculptures on the façade of the New Opera House, Paris (1869); 'The Fount of Poetry' (1873); 'Aopheus' (1878); 'Two Hermes'; 'Anacreon with Eros'; and 'Sappho with Eros and Andromache.' He was the designer of the medals given at the expositions of 1867 and 1878.

Guillemet, Jean Baptiste Antoine, zhŏṅ bäp-tēst äṅ-twän gwĭ-yĭ-mā, French painter: b. Chantilly 1842. After studying under Corot and Oudinot he exhibited for the first time in 1865. He chooses for his subjects the scenery of Normandy, and the Seine valley, and is faithful in his transcripts from nature, but his work lacks the color and subtility as well as the imagination of the Barbizon school. His 'View of Bercy' and 'View of Paris' are in the Luxembourg.

Guillotine, gĭl'ō-tēn, a machine for beheading, so called from Dr. Joseph Ignace Guillotin, and introduced during the French revolution. It consists of two posts united at the top by a cross beam, and furnished with grooves, in which a broad steel blade heavily weighted with lead descends by the impetus of its own weight on the neck of the criminal, fastened to a plank beneath. The certainty and speed with which this instrument separates the head from the body gives it an advantage over the axe or sword wielded by the hand. Machines of a similar description have been in use among many nations. In Italy, from the 13th century, it was the privilege of the nobility to suffer capital punishment by an instrument called the *mannaia,* closely resembling the guillotine. In Germany, likewise, during the Middle Ages, an instrument resembling the guillotine was made use of, though the blade did not fall upon but was thrust through the neck of the criminal. There was formerly employed in Great Britain, also, and more especially in Scotland, an instrument of decapitation called the "maiden," said to have been introduced by Regent Morton, who himself afterward suffered by it. It differed from the guillotine in this, that while the blade of the guillotine falls upon the neck of the criminal, in the maiden the blade is fixed with its edge upward, and the neck of the criminal is forced down upon it by the fall of a heavy weight. Such an apparatus was also known and used at an early period in France. The Dutch likewise formerly made use of a decapitating machine.

Dr. Guillotin was not the inventor of the instrument which bears his name, and had only a secondary share in its introduction into France. As a member of the constitutional assembly he proposed to that body to abolish all class distinctions in the method of inflicting capital punishments, and with that view to have some instrument invented which might do the work more quickly and certainly than the hand of the headsman. The establishment of a new penal code having now become the subject of deliberation, a vote for a uniform system of capital punishment was, on the motion of Dr. Guillotin, passed on 21 Dec. 1789, with a recommendation that the least painful method of inflicting it should be adopted. It was not till 1792, however, that this special machine was selected after a report from Dr. Ant. Louis, secretary to the College of Surgeons. The guillotine was first erected in the Place de Grève at Paris, and the first execution performed by it on 25 April 1792, on a highwayman. Shortly afterward, in remembrance of Guillotin's original proposition, it received the name of "guillotine," both popularly and in official language, and it was introduced wherever the penal code of France has been adopted.

Guimaras, gē-mä-räs', Philippines, an island lying west of Negros and south of Panay, forming with Panay the strait of Iloilo. The east coast is mountainous, the west coast, open and fertile; an excellent road follows the entire coast, except for a distance of 10 miles, and the most important towns are on this road. The products include rice, corn, cotton, and tobacco, and there are important fishing interests. The island is a part of the province of Panay.

Guimbal, gēm-bäl', Philippines, a pueblo of the province of Iloilo, island of Panay, situated on the southeast coast, at the mouth of a river, 17 miles west of the town of Iloilo. Pop. 10,950.

Guinaan, gē nä'an, a Malay tribe of the Philippines, inhabiting the watershed of the Rio Abra and the Rio Grande de Cagayan, island of Luzon, and the neighboring region of Isabela and Abra. They are a heathen, head-hunting tribe, and have a distinct language.

Guinea, gĭn'ē, an English gold coin, first issued in 1663; by a proclamation issued 22 Dec. 1717, the guinea was declared current at 21*s.* sterling. Its true value, as derived from the market values of gold and silver at that time was 20*s.* 8*d.*, about $4.96. It has not been coined since 1817, when the sovereign supplanted it, but the fashion still prevails of quoting prices of some things in guineas, and subscriptions are frequently recorded in the same denomination.

Guinea-corn, a name given to durra, *Sorghum vulgare,* cultivated in the United States under the name of broom-corn. See DURRA; BROOM-CORN.

Guinea-fowls, a family of gallinaceous birds (*Numididæ*) allied to the pheasants and turkeys, natives of Africa and Madagascar. Twenty-three species are known, the most familiar being the common guinea-fowl of our poultry yard (*Numida meleagris*). This bird ranges in a wild state from Senegambia to the Niger

River, and is found also on the Cape Verde Islands. It is supposed to have been first brought to Europe by Portuguese explorers in the 16th century; but these fowls were domesticated in Rome during the classic period. Of the other species the vulturine guinea-fowl (*Acryllium vulturinum*) is one of the handsomest, being striped with brilliant blue; while the black guinea (*Phasidus niger*) and the turkey-like guinea (*Agelastes meleagrides*) are peculiar in possessing spurs.

Guinea-grass, a kind of grass (*Panicum maximum*), often 6 or 10 feet in height, a native of western Africa, which has been naturalized in South America and the West Indies, and is largely cultivated for fodder.

Guinea, Gulf of, that portion of the Atlantic on the coast of Africa, between Capes Lopez and Palmas. Two of its arms are the bights of Benin and Biafra. The Niger flows into this gulf south of the bight of Benin. A number of small streams enter from French Kongo and Kamerun. It contains a number of islands, chief of which are St. Thomas, Fernando Po, and Prince's Island. The gulf has two currents, one setting eastward into the bights of Biafra and Benin, and the other coming from the south; they meet in the bight of Biafra, and unite in one stream which gradually expands as it flows northwest, then west and southwest.

Guinea-pig, or **Cavy,** a small, variable domesticated race of the restless cavy (see CAVY), bred in all parts of the world as a children's pet. It is about six inches long, and exists in several races, some short-haired, others with long, curiously ruffled hair. The colors are greatly varied, white, black and a mixture in quaint pattern of white and tan being preferred. It is a restless, grunting little creature, showing a small amount of intelligence, but gentle and amusing. It feeds on vegetables, bread, parsley, lettuce, etc., and is exceedingly cleanly in its habits. It begins to breed when five or six months old, the period of gestation being from 9 to 10 weeks, and the litters averaging from 4 to 5; and this extreme fecundity seems to be its only means of defence against extinction. The name is probably a corruption of "Guiana-pig," referring to its native home and its pig-like form and grunting. English children call them "cavies." They are bred by fanciers for show purposes, and clubs exist for the improvement of standard breeds.

Guinea-worm, a nematode worm (*Filaria medinensis*), the female of which may be three feet long, and as thick as a knitting-needle. It is a parasite in the feet and toes of residents of the East Indies and African coast, forming abscesses beneath the skin in which the worm is coiled up. It produces the disease known to the Greeks as dracontiasis, and one of those now called filariasis (q.v.). To extract the worm it must be slowly wound upon a roll of paper, a little at a time, care being taken not to break the worm, as if a portion is left in the abscess, the young will develop and be scattered under the skin. Although formerly confined to the Old World, the guinea-worm has recently been found in the tropics of America, but is very rarely seen in northern parts.

Guinevere, gwĭn'ĕ-vēr, the wife of King Arthur in the Arthurian legends (q.v.). In the first accounts of the Arthurian court, she plays a very unimportant part, and her character is not clearly portrayed. It is in the 13th century that the personality of the queen and the story of her love for Lancelot are first developed. The most vivid and powerful picture of Guinevere is that given by Tennyson in the 'Idylls of the King,' in which her sinful love for Lancelot is made the real cause of the downfall of the Round Table and Arthur's kingdom.

Guiney, Louise Imogen, American poet: b. Boston 7 Jan. 1861. She began to write for publication in 1880 and was a frequent contributor to 'The Pilot,' Boston. Her published works include 'Songs at the Start' (1884); 'The White Sail and Other Poems' (1887); 'A Roadside Harp' (1893); 'Martyr's Idyl and Shorter Poems' (1899); and in prose she has also published: 'Goose-Quill Papers' (1885); 'Brownies and Bogies'; 'Monsieur Henri' (1892); 'A Little English Gallery'; 'Lovers' Saint Ruths'; 'Patrins' (1897); 'The Secret of Fougereuse'; etc. She has edited an edition of Mangan's poems.

Guinness, SIR **Benjamin Lee,** Irish philanthropist: b. 1 Nov. 1798; d. 19 May 1868. He was a member of the great Dublin brewing firm, the largest in the world. In 1865–8 he was M. P. for Dublin. He restored St. Patrick's Cathedral, Dublin, at a cost of $700,000. His business in 1886 was placed in the control of a limited liability company, employing 3,000 persons and having a capital of £6,000,000.

Guinness, SIR **Edward Cecil,** Irish philanthropist: b. 10 Nov. 1847. He was the son of Sir B. L. Guinness (q.v.). In 1891 he became Baron Iveagh. He gave $1,250,000 for the purpose of erecting sanitary dwellings for working people at a low rent. Of this sum $1,000,000 was to be given to London, and the remainder to Dublin. The income obtained on the capital is to be employed in the same fashion.

Guinobatan, gē-nō-bä'tän, Philippines, a town in the province of Ambos Camarines, island of Luzon, on the Quinali River. Pop. 10,000.

Guise (gü-ēz or gēz) **Family, The,** French ducal house, a branch of the family of Lorraine. The founder was Claude, a younger son of René II., duke of Lorraine, who in 1506 became naturalized in France, and in 1513 married Antoinette de Bourbon, the daughter of the Count of Vendôme. In his favor the county of Guise (one of his numerous possessions in France) was erected in 1528 by Francis I. into a duchy. He died in 1550, leaving behind him five daughters (the oldest of whom, Marie, married James V. of Scotland, and was the mother of Mary, queen of Scots) and six sons — François, who succeeded him in the duchy of Guise and his other dignities; Charles (usually known as Cardinal of Lorraine), Louis (Cardinal of Guise), Claude, François, and René, all persons of note. The family acquired great political importance on the accession of Francis II., who was married to Mary, queen of Scots. François, the second duke of Guise, was assassinated in 1563, and left three sons, Henri who inherited his father's titles; Louis, cardinal of Lorraine and archbishop of Rheims (both put to death in 1588 on the command of Henry III.); and Charles, duke of Mayenne. Henri, third duke

of Guise, was succeeded by his son Charles, who died in Italy in 1640, and was succeeded by his second son Henri. Henri died without issue in 1664, when he left the title to his nephew, Louis Joseph, duke of Joyeuse and Angoulême. His son and succesor, François Joseph, died in 1671, leaving only one son, who died at the age of five in 1675, when the direct line of the house of Guise became extinct. In 1704 the title was revived for the house of Condé.

Guise, France, a town in the department of Aisne, on the Oise, 25 miles by rail northeast of St. Quentin. It is an ancient city, mentioned as early as 1050, and has interesting remains of the 16th century castle of the famous Dukes of Guise. The town is noted for the ironworks of Dequerème et Cie founded by Jean Baptiste André Godin, and conducted on a profit-sharing plan. The workmen are provided with dwellings on the associated plan; the first portion of the *familistère* was erected by Godin in 1859–60 at a cost of $400,000. In connection with the workman's colony is a *phalanstère,* or common dwelling-house accommodating 400 families, a theatre, library and reading-room, schools, nursery, covered playgrounds, and a co-operative store. Pop. (1901) 7,300.

Guitar', a stringed musical instrument, with an oval body, and a neck like that of the violin. The modern or Spanish guitar has six strings, the three highest of gut, the three lowest of silk covered with fine wire, and tuned to the E in the second space of the bass staff, A, its fourth, and the treble D, G, B, and E The intermediate intervals are produced by bringing the strings, by the pressure of the fingers of the left hand, into contact with the frets fixed on the key-board, while those of the right pluck or twitch the strings. The Spaniards are supposed to be the inventors of the guitar, and it is most widely used in Spain, though its use is quite general in other countries.

Guiteau, gē-tō', **Charles Julius,** American assassin: b. about 1840; d. Washington, D. C., 30 June 1882. He became a lawyer in Chicago, and in 1880, after the election of James A. Garfield to the presidency, went to Washington, presumably to secure the office of United States consul at Marseilles, but did not succeed. Owing to this and the fact that the new President was opposed to the Stalwarts, led by Roscoe Conkling, Guiteau became greatly incensed. On 2 July 1881, he shot the President in the waiting room of the Baltimore and Potomac Railroad station in Washington; and on 19 Sept. the President died from the effect of his wound. Letters taken from Guiteau after his arrest showed that he had planned to "remove" the President. He was indicted for murder on 7 October, was found guilty on 25 Jan. 1882 after a sensational trial in which insanity was the only plea offered for the defense, and was hanged in the District of Columbia jail, 30 June following. See GARFIELD, J. A.

Guiuan, gē'wän, Philippines, a pueblo of Sámar, on the extreme south coast, 78 miles southeast of Catbalogan, having a good harbor. On the edge of a reef near the town are several sulphur springs, which though covered by the sea at high tide, are never brackish. Pop. 11,300.

Guizot, François Pierre Guillaume, frän-swä pē-âr gē-yōm gē-zō, French historian and statesman: b. Nimes 4 Oct. 1787; d. Valricher near Paris, 13 Sept. 1874. His father, a lawyer, having in 1794 perished by the guillotine, his mother and her three sons retired to Geneva, where François was gratuitously educated at the gymnasium. In 1805 he commenced the study of law at Paris, but gradually drifted into the literary profession. In 1812 he married Mlle. de Meulan, editor of the 'Publiciste,' and became professor of history at the Sorbonne. On the fall of the empire he obtained several public offices, such as councillor of state, and director-general of the departmental and communal administration. In 1816 he published 'Du Gouvernement Représentatif et de l'Etat Actuel de la France,' and 'Essai sur l'Instruction Publique.' In 1820 the Duc de Berry was assassinated, and Guizot's party fell before an ultra-royalist reaction. In 1825 he lost his chair on account of the political character of his lectures, but regained it in 1828. In 1829 he again became councillor of state, and after the July revolution was appointed minister of the interior, but resigned in 1831. After the death of Périer, Guizot, along with Thiers and De Broglie, formed a coalition ministry, and rendered great service as minister of public instruction. He became ambassador at the British court in 1840, and next year was the real head of the government of which Soult was the nominal chief. He retained the office of minister of foreign affairs until 1848, and during that period opposed all measures of reform. After the fall of Louis Philippe, Guizot escaped, fled to England and though he returned the next year he henceforth practically retired from public life. Born of a Calvinist family, he always remained a stern Protestant of the orthodox type, although he zealously supported the temporal authority of the pope. Among his numerous works may be mentioned, 'Histoire de la Civilisation en France' (1830); 'Histoire générale de la Civilisation en Europe' (1828); 'Histoire de la Civilisation d'Angleterre' (1827); 'Washington'; 'Discours sur la Révolution d'Angleterre'; 'Méditations et Etudes Morales'; 'Guillaume le Conquérant'; 'Mémoires pour servir à l'Histoire de mon Temps' (1858–68); 'Méditations sur l' Etat Actuel de la Réligion Chrétienne' (1865); 'Mélanges Biographiques et Littéraires'; 'Histoire de France Racontée à mes Petits Enfants' (1870); etc.

Gujarat, gŭzh-rät', or **Guzerat, India, a** region bordering on the Arabian Sea, comprising part of the northern section of the presidency of Bombay and some native states. Area of the whole, about 70,000 square miles; pop. about 11,000,000.

Gulf of Saint Lawrence. See SAINT LAWRENCE, GULF OF.

Gulf-stream. See CURRENTS, MARINE.

Gulfport, Miss., city in Harrison County, on the Gulf of Mexico, and the Gulf & Ship Island and the Louisville and N. R.R.'s. Gulfport has grown in 5 years from a seacoast hamlet to a thriving city. The keynote of its success is the fact that it has one of the best harbors on the Gulf of Mexico. Prominent among its public buildings is the "Great Southern" hotel, with its 250 rooms, intended as a winter resort for Northerners and as a summer

resort for the people of the South, especially those of New Orleans. It is situated directly on the shore and is undoubtedly the finest resort hotel between Tampa and New Orleans. Other prominent buildings are the county courthouse and those of the First National bank and of the Gulf & Ship Island railroad. The latter is used for the offices of the company. The First National bank is now the largest bank in the State of Mississippi, having a capital of $250,000. The most important manufacturing plants are oil and fertilizer factories, the Gulfport Packing Company and the shops of the Gulf & Ship Island railroad. There are, also, numerous smaller concerns, such as iron foundries and wood-working plants. Pop. (1900) 1,020; (1903) 3,500.

Gulfweed, a genus (*Sargassum*) of seaweeds of the sub-order *Fucaceæ,* which grow in deep water along all warm coasts, and becoming easily detached, are found floating in immense quantities in the middle of all oceans, where they accumulate in vast eddies, as it were, of the oceanic currents. The North Atlantic species (*S. bacciferum*) is the best known, and takes its popular name from its presence in long yellow lines in the Gulf Stream; and its specific name from the berry-like appearance of its air-vessels. The frond is very long, and is furnished with distinct, stalked, nerved leaves, and simple axillary stalked air-vessels; and its structure approaches that of the higher plants. Where the Gulf Stream is deflected from the banks of Newfoundland eastward, and sends off its more southern branch toward the Azores, is situated the Sargasso Sea, "that great bank of weeds, which so vividly occupied the imagination of Christopher Columbus, and which Oviedo calls the seaweed meadows" (Humboldt). The quantity of floating seaweed is often such as to impede the progress of ships. Multitudes of small marine animals accompany it, with fishes ready to prey on them, constituting a distinct and considerable fauna. The gulfweed is eaten in China, and in other parts of the East also it is used in salads and as a pickle.

Gu'lick, John Thomas, American clergyman: b. Kauai, Hawaii, 13 March 1832. He was graduated at Williams College in 1856, studied theology at the Union Theological Seminary, went to China as a missionary, and subsequently to Japan. He is a well-known writer on topics relating to evolution and natural history. He contributed to the 'Journal' of the Linnæan Society of London: 'The Diversity of Evolution under One Set of External Conditions' (1872); 'Divergent Evolution Through Cumulative Segregation' (1887); 'Intensive Segregation' (1889); and other monographs.

Gulliver's Travels, a famous satire by Jonathan Swift anonymously published in 1727. It is one of the most brilliant and profound of satires, became immediately popular, and has never lost its interest for both young and old. It begins with Gulliver's account of himself and his setting forth upon the travels. A violent storm off Van Diemen's Land drives him, the one survivor, to Lilliput, where he is examined with curiosity by the tiny folk. His next voyage is to Brobdingnag, where he is a Lilliputian in comparison to the size of the gigantic inhabitants of this strange land, in which he becomes a court toy. The next adventure is a voyage to Laputa, where the inhabitants are absorbed in intellectual and scientific pursuits, and "taken up with intense speculations," and their conduct is most eccentric; this is probably a satire upon pedantry. The last voyage takes the traveler into the country of the Houyhnhnms, where the horses under this name have an ideal government,— Swift's Utopia,— and are immensely superior to the Yahoos, the embodiment of bestial mankind.

Gulls, a large group of sea-birds found throughout the world and constituting, together with the terns (q.v.), skimmers (q.v.), and skuas or jaeger-gulls, the family *Laridæ* (q.v.). Some 53 species of gulls are known, ranging in size from that of a pigeon to that of a goose. The prevailing color is pure white below and pearl gray above, while some species have a gray or blackish head, and a few are dull gray all over. The young birds of all species are dusky during the first year. They walk with tolerable ease, and swim well, but are incapable of diving. They keep much on the wing, and their flight is rapid, strong, and long sustained, even in heavy gales. In sitting they contract their necks and rest on one foot. They nest along the shores in the grass, on rocky cliffs or rarely in small trees, forming the nest of dry grass, sedges, etc., and invariably in colonies, creating a great uproar when their nesting-grounds are visited. The wild characteristic note is, in the bigger species, harsh and querulous, in the smaller a "laughing" or screaming; the lesser skuas give vent to a curious mewing cry and the great skuas to a similar but deeper sound. At the breeding-quarters the utterances are naturally more agitated and shrill, and the parents hang excitedly above a visitor's head. "The food," says Evans, "consists mainly of fish, mollusks, crustaceans, and worms, but is varied in the stronger forms by small mammals, young birds, and eggs; the great black-backed gull undoubtedly attacks lambs and weakly ewes; carrion is not uncommonly devoured; and *Larus maculipennis* acts as a scavenger at Buenos Ayres, besides clearing the country of grasshoppers, and robbing the Cayenne lapwing of its insect booty. Skuas give chase to their smaller kin, and force them to disgorge the fishes they have just caught, while even solan geese are sometimes victimized; *Larus scopulinus,* moreover, which robs the oyster-catcher of New Zealand, is a further instance of parasitic habits. Insects and their larvæ, turnips, berries, and grain are also eaten by these omnivorous but useful creatures."

Most gulls are migratory and scatter far along the coasts during fall and winter in search of food. On the eastern coast of the United States are five species. The large herring-gull (*Larus argentatus*) breeds on the coast of Maine and winters to the southward, being abundant about all harbors and along tidal rivers from October to April. Associated with them are sometimes seen the larger black-backed gull (*L. marinus*). In summer are present the smaller black-headed or laughing gull (*L. atricilla*) which nests plentifully on the salt marshes of the Middle and Southern States. The Bonaparte's and ring-billed gulls (*L. philadelphia* and *L. delawarensis*) breed on our northern coasts. In the interior Franklin's gull (*L. franklini*) inhabits the lake shores and marshes of

the upper Mississippi Valley; while on the Pacific coast occur several other species. In the arctic regions the most abundant gull is the great Burgomaster (*L. glaucus*), one of the largest species, which wanders some distance southward in winter. Two other species peculiar to the far north are the pure white ivory gull (*Pagophila alba*) and Ross's rosy gull (*Rhodostethia rosea*). The latter is one of the rarest of birds and one of the most beautiful, the whole under surface being suffused with pink and the neck surrounded by a dainty collar of gray. It has been seen in numbers only by the arctic explorers Murdoch and Nansen. The Kittiwake (*Rissa tridactyla*) is another species of circumpolar distribution, peculiar in lacking the hind toe. Several of these species are known on the coasts of Europe or Asia; and the gulls of other parts of the world present little that is peculiar. Large areas of coastal beaches and islands formerly inhabited by gulls in various parts of the world, but especially along the eastern coast of the United States, have been wholly depopulated of these beautiful and useful birds by the incessant robbery of their nests for the sake of the eggs — which are conical in form, and white or greenish, heavily blotched with purple and brown in color;— or for the sake of their plumage to be used in millinery trimmings. Protective laws now prevent this waste of life.

Consult Evans, 'Birds' (1900); Coues, 'Birds of the Northwest' (1874); Baird, Brewer and Ridgway, 'North American Water Birds' (1884).

Gum Arabic, a gum of the *Acacia arabica*, which grows in India and Arabia. Gum arabic can be obtained also from *Vachellia farnesiana* of India, a small tree closely allied to the true acacias. Gum arabic occurs in transparent white tears, which are often colored yellow or brown by impurities; it cracks on exposure to the air on the surface; it is brittle, and has a bland, mucilaginous taste. It dissolves in water, and the solution gives a precipitate of arabin on the addition of hydrochloric acid. Gum arabic contains about 70 per cent. of arabin, $2C_6H_{10}O_5+H_2O$, and 17 per cent of water; the rest consists of potash and lime, which are combined with the arabin.

Gum-boil, an abscess in the gum caused by inflammation, generally the result of toothache or of the presence of decayed teeth. The carious tooth or stump, if the inflammation proceeds from this cause, should be removed. When matter has formed it should be evacuated by a free incision, and the mouth should be frequently washed with tincture of myrrh and water. See DENTISTRY; TEETH.

Gum-resins are complex mixtures obtained from plants. They contain both a gum, which is soluble in water, and a resin, which dissolves in spirit. There are usually present in addition essential oil, coloring and extractive matter, and a variety of impurities. The gum-resins have frequently a strong and characteristic taste and smell. They are solid, opaque, and brittle. The common gum-resins are aloes, ammoniacum, asafœtida, euphorbium, galbanum, gamboge, myrrh, olibanum, opoponax, sagapenum, and scammony.

Gum-trees, a name for several different trees: (1) those of the Australasian genus Eucalyptus (q.v.); (2) in the United States, the pepperidge or tupelo, various species of which are called black, sour, cotton-gum, etc. (see TUPELO); (3) the liquid amber (q.v.).

Gumbinnen, goom-bĭn'nĕn, Prussia, the capital of a government with an area of 6,125 square miles. The town is on the Pissa, 22 miles by rail southwest of Edytkuhnen on the Russian frontier. It is comparatively modern, its municipal charter dating from 1722. There are manufactures of woolens and linens, and a trade in cattle and agricultural produce. Pop. (1903) 14,000.

Gumbo. See HIBISCUS; OKRA.

Gumma, gŭm'a, a tumorous deposit that occurs in the tertiary stage of syphilis (q.v.). It affects most frequently the bones, cartilages, skin, and periosteum. They are made up of a hard connective tissue which tends to undergo softening, causing destruction of the part and deep ulceration if near the surface. The periosteum of the cranial bones is particularly liable to be affected, causing dangerous pressure on the brain.

Gumming, or Gumosis. See DISEASES OF PLANTS.

Gums, various mucilaginous substances, generally obtainable from the sap of trees. They are soluble either in cold water or in alcohol. Many aromatic products such as are employed in making perfumes and incense are to be classed as gums. Gum Arabic is the best known among such products. It is obtained from the Senegal Acacia in Western Africa. There are no less than eight or nine varieties of this gum. Gum tragacanth comes from the *Astragalus gummifer*, in Western Asia. Cherry-tree gum, whose name tells its origin, is used for stiffening felt, as in hat making. There are some gums which might perhaps more properly be classed as resins, and are sometimes styled gum-resins; many of which are used in medicine.

Gun, a strongly-constructed metal tube, from which destructive projectiles are expelled by the gradually increasing pressure of gas, evolved from fired gunpowder or other explosive. The term comprehends every description of firearm, from cannons, mortars, and other heavy pieces of ordnance, to the fowling-piece, rifle, and pocket-pistol. See ARMS; ARTILLERY; FIRE-ARMS; ORDNANCE.

Gunboat, a term originally applied to small craft mounting usually a single gun, and employed exclusively in the defense of coasts and rivers. Experiences in the Crimean war suggested the extension of the use of gunboats to offensive warfare. One of the main objects of a ship of war being to carry guns, it was thought that a vessel large enough to carry only a single gun of the largest size would, from the rapidity with which it could be manœuvred, and its comparative immunity from shot, have great advantages in attack against large vessels carrying a heavy armament, and requiring much room and time to manœuvre. About 1860 the British government constructed about 200 gunboats upon this principle. They were about 100 feet long, with 22 feet beam, and a draught at load-line of 6½ feet. Each was armed with one deck-gun, a 68-pounder, which, by turning on a pivot, could

be used either ahead, astern, or in any other direction; while the facility of manœuvring was further enhanced by the rapidity with which the vessel itself could be turned almost in her own length. Experience soon proved that there were serious defects in this species of armament. One of these was, that from being obliged to carry their guns constantly on deck the gunboats were liable to be top-heavy and untrustworthy in a heavy sea.

A new gunboat was designed in England in 1868 by G. Rendel, the chief peculiarity of which was the placing of the gun on a platform, which could be raised to the deck or lowered to the hold by a donkey-engine. The gun did not turn on a pivot, the manœuvring being effected entirely by the turning of the vessel, to effect which it was fitted with twin-screws worked by independent engines. Other types of gunboat have since been constructed for the British navy. One of a recent and powerful type is 165 feet in length, with a breadth of 31 feet, and a displacement of 805 tons. It draws 11 feet 7½ inches of water, and has triple-expansion engines, working up to 1,200 horse-power, with a speed of 13 knots an hour. It carries six 4-inch steel breech-loading guns, besides two quick-firing guns and machine-guns, and is bark-rigged. A number of what are known as torpedo gunboats have been constructed for the British navy. One boat of this class is 200 feet in length, with a beam of 23 feet, and a depth of 13 feet. It is built entirely of steel, has a torpedo-tube through the bow and another through the stern in a fore-and-aft line, and one on each broadside forward, a 4-inch 25-cwt. central-pivot breech-loading gun, and six 3-pounder, quick-firing guns. It has two sets of triple-expansion engines, working up to 2,700 horse-power, and enabling the vessel of 450 tons to steam over 18 knots an hour. Several first-class gunboats of a more recent type are twin-screw vessels, 180 feet long, of 700 tons displacement, armed with two 4-inch guns and four 12-pounder quick-firing guns.

In the United States the gunboat figured to a very considerable extent in coast and lake warfare in our first two wars. They were first used on the Delaware River, in 1775–6, and drove the British frigate Reliance out of the roads. In December 1807 there were 69 of them in United States service, and the Congress ordered 188 more built, as an auxiliary to the embargo declared a few days later, making 257 in all. Improved ordnance has made them valueless, and they had a bad effect on the service, but there was strong opinion in their favor at the time, and they did good service in the War of 1812. The theory was that these movable batteries could act in water where large vessels could not, could be concentrated against the latter so as to afford as large an armament, yet present only a number of small targets, while their antagonist presented only one large one; that shots aimed too high would do no harm to gunboats, but would injure masts and rigging of frigates; that loss of rudder and sailing gear, the most crippling of accidents to a ship, could not happen to the gunboats, propelled and steered by sweeps; that nearness to the water level gave the guns more accurate aim; and that 75 gunboats could be built for the cost of one 36-gun frigate.

In 1903 the United States navy had 20 of the ordinary gunboats in commission and about 60 torpedo-boats and destroyers of the gunboat type. Great Britain in 1902 had 33 torpedo gunboats, Germany 3, and France 15. In most countries the gunboat has been superseded by modern torpedo-boats and destroyers.

Gun-carriage, or **Gun-mounting**. See Artillery; Fortification; Ordnance.

Guncotton is the name originally assigned to the material produced by Schoenbein, of Basle, Switzerland, in 1845 by treating cotton with a mixture of strong nitric and sulphuric acids. The discovery that starch, woody fibre, and similar substances give rise to the formation of highly combustible bodies when acted upon by concentrated nitric acid is attributed to Braconnot in 1832, and he styled the bodies so produced generically *xyloidine*. Six years later Pelouze took up this subject and extended his investigations to the behavior of cotton, paper and vegetable substances generally, and later Dumas prepared from paper by this means the substance which he called *nitramidine*. No practical result followed these observations until the discovery by Schoenbein of the advantages which followed the use of the acid mixture; a discovery which was also independently made by Boettger, of Frankfort, in 1847 and by Knop, of Hanover, and Taylor, of England, in 1847. The discovery aroused the liveliest expectations which were stimulated by the facts that the explosive was much more powerful than gunpowder and that when used as a propellant, it gave little or no smoke. Experiments and tests were begun shortly after with the new explosive in Germany, France, Austria, England, Russia, and the United States with a view of utilizing it as a substitute for gunpowder in guns. Unfortunately the material, as manufactured, was found to be not only so irregular in action that it was likely at any time to burst the piece, but also so unstable as to give rise to numerous accidents so that, especially after the serious and, at the time, inexplicable explosions at Vincennes and Bouchet in France, and Faversham in England, the experiments were discontinued except in Austria, where Baron von Lenk gave the matter close and long-continued study and came to the conclusion that the grave defects noted were not inherent in the material, but were due to the imperfect and irregular methods of manufacture, the failure to purify the cotton before treatment with the acid, and the failure to purify the guncotton and free it completely from acids after treatment. Following these convictions he improved the method of manufacture to such an extent that in 1862 the Austrian army had 30 batteries provided with guncotton cartridges made up by twisting the fibre into yarns which were braided together, but the spontaneous explosions at the magazine at Simmering in 1862 and at Steinfeld in 1865, together with the fact that the guncotton cartridges still gave at unexpected times abnormal pressures led to its further use in Austria being interdicted.

Von Lenk's process of manufacture was patented in England in 1862 and the Prentice Brothers began manufacturing under this process in 1864. In 1865 Abel patented an improvement of the process which was so successful in use that it gave guncotton a prominent and

permanent place among explosive substances, and this process is followed to-day. The cotton when treated with the acid is in the fibrous condition which so well characterizes it, and under the microscope these fibres are seen to be hollow so that each is really a capillary or hair-like tube. Von Lenk had shown that cotton contains not only cellulose as the main component of its structure but that there were smaller and variable quantities of other substances naturally present besides foreign bodies accidentally present, and that it was necessary to get the cellulose in a pure and dry condition before treating it with acid. He, too, with others, had proved that the purity, strength and proportions of the acids used and the time and temperature of immersion of the cotton in the acid mixture affected very materially the character of the substance produced, while it was essential that every trace of free acid should be removed from the product, since a most minute quantity of sulphuric acid acts continuously and cumulatively on the guncotton and causes a progressively increasing rate of decomposition. Yet von Lenk and all others up to this time produced the guncotton in the same long staple form as the cotton from which it was made. It was evident to Abel's mind that as the dry cotton was immersed in the acid mixture the capillary tubes, of which it was composed, would suck up the liquid acid and retain it with such force and in such a manner as to make its removal by wringing, or washing with or in water or by neutralization with alkalies, extremely difficult and uncertain, and to remedy this Abel proposed to pulp the guncotton through which the fibres would be cut into such short lengths that the acids could be completely and readily removed from the interiors of the tubes while furthermore this pulped material could by molding and pressure be shaped into any desired forms and dimensions.

Abel's process for the manufacture of military guncotton as carried out at the United States naval torpedo stations was as follows: The cotton used was what is known as «cop» or weaver's waste, which is the tangled clippings from the spinning room of a cotton mill; the thready form of this material being preferred to the fluffy form of the unworked cotton. This was first hand-picked to remove the larger foreign bodies present and to open out after baling. It was then boiled in 200-pound lots in caustic soda solution to remove grease, oils and the incrusting substances on the fibres, then wrung out in a centrifugal wringer and dried in a heated closet. It was then put through a cotton picker to open up the fibre and remove foreign bodies which had been overlooked in the hand-picking, and was then dried in a second closet at 225° F. until it contained not over one half per cent of moisture, when it was stored in small lots in hermetically sealed metal vessels to cool. It was then dipped in lots of one pound each in 150 pounds of acids, consisting of 1 part by weight of nitric acid, 1.5 specific gravity, to 3 parts by weight of sulphuric acid, 1.845 specific gravity, contained in a large iron trough about which cold water circulated so as to maintain a temperature of 70° F. throughout the dipping. The cotton was plunged rapidly under the acid, allowed to remain immersed for 10 minutes, removed to a shelf above the acid dipping trough, where it was squeezed to remove the excess of acid, and then at once transferred to a two-gallon crock made of acid-proof earthenware. As transferred to this digestion crock the cotton carried with it from 10 to 12 pounds of the acid mixture, and by pressing the mass down in the crock with an iron tool, the cotton was forced to the bottom and covered with a layer of the acid mixture which was squeezed from it. The crock was then covered and placed in a wooden trough where it was partly surrounded with cool water, which was kept in constant circulation, and where it was allowed to remain, so that the cotton could «digest» the acid, for 24 hours. Then the contents were thrown into a steel centrifugal wringer by which the greater part of the acid was removed. The guncotton was then thrown into a tub holding 800 gallons of water through which a large stream of water was continually flowing and in which a large paddle-wheel was in revolution so as to very quickly bring the acid guncotton into contact with so large a volume of cold water as to prevent its becoming heated. The guncotton was then boiled twice for eight hours each in a dilute solution of soda, wrung out and washed with fresh water and put in the pulper. This was an ordinary «beater,» «rag-engine,» or «Hollander,» such as is used in the paper-making industry, and the guncotton, suspended in water, was subjected to the action of the machine for two days in charges of from 300 to 350 pounds, where, by the shearing action of the knives, the fibres were cut into short lengths and the guncotton was reduced to the fineness of cornmeal, and mixed into a pulp with the water present. This was drawn into a large tank, known as the poacher, where the powdered guncotton was allowed to settle and the supernatant water drawn off. Fresh water was added and, by means of a revolving paddle in the poacher, the guncotton was mixed with it and washed by it, and this washing was repeated six or seven times until the chemical test of a sample showed that the acid had been completely removed. Then it was treated with a solution of lime containing a small quantity of caustic soda and also of precipitated chalk, and the mass was ready for molding.

As shown above the first use to which guncotton was put was as a propellent in guns, and Abel devised means for making powder grains from the pulped guncotton, but he soon pointed out the advantages which it possessed, when compressed, for use in military and naval mines and torpedoes and for engineering operations in times of war, and these are the chief uses to which it has been put. To compress it the alkaline solution from the poacher, containing the finely divided guncotton in suspension, was pumped up to a stuff-chest, which is a cylindrical tank containing a vertical shaft armed with paddle-blades which, by revolving, keeps the guncotton in suspension. From here, by means of a wagon, the pulp was run into a hydraulic press where it was subjected to a pressure of 100 pounds to the square inch and thereby molded into blocks. These blocks were then transferred to another press where they were subjected to a pressure of from 6,000 to 6,800 pounds to the square inch. As made at the United States naval torpedo stations the blocks from the molding press were prismatic, with the vertical edges chamfered, 2.8 inches in

diameter by $5\frac{1}{4}$ to $5\frac{1}{2}$ inches high, with a circular hole $\frac{1}{2}$ inch in diameter, produced by a mandrel in the press, running vertically through the centre of the prism. After final pressing the blocks were 2.9 inches in diameter by 2 inches high, the hole remaining practically unchanged, and they still contained from 12 to 16 per cent of water, though as sent out into the service as "wet guncotton" they were soaked in water until they contained 35 per cent. In the final press by means of steel dies, inscriptions in letters and figures, such as the place and date of manufacture and factory lot, were placed upon each block.

In the fibrous condition guncotton appears like the cotton from which it is made, but it has a harsher feel and it becomes electrified by friction when dry. When dry if rubbed in the dark it becomes phosphorescent. Under the microscope by polarized light it exhibits colors, while cotton is colorless. Pure guncotton is without odor or taste and is insoluble in water. The gravimetric density before pulping is 0.1, after pulping 0.3, and after compression from 1.0 to 1.3, but by excessive pressure it has been raised to 1.4. The real specific gravity of guncotton is 1.5. When dry, compressed guncotton is detonated by inserting a detonator in the hole in the block and firing it. Wet guncotton is detonated by the detonation of a block of dry guncotton fired in contact with it. The violence of the explosion of guncotton when thus detonated is comparable with, if not superior to, that of nitroglycerin. Dry guncotton may be set on fire and, when compressed, it burns so slowly in the open that the fire may be extinguished by pouring water upon it. Wet guncotton, thoroughly saturated with water, can be shaped by a tool without taking fire or exploding. In forming the cylindrical and conical charges for the torpedoes thrown from the pneumatic guns of the United States steamship Vesuvius at Santiago, the prismatic blocks above described were sawn with a band saw, turned in a lathe and cut with chisels as wood is treated, but care was used to keep the blocks and dust wet throughout the process.

Pure cotton is composed of cellulose having a formula which chemists believe to be some multiple of $C_6H_{10}O_5$. When it is acted upon by nitric acid or mixtures of nitric with sulphuric acid, under the proper conditions, cellulose nitrates are produced through, it is believed, the replacement of hydrogen atoms in the molecule by NO_2 groups, thus forming esters or organic salts. Views differ as to the number of cellulose nitrates existing but, following Vieille, who is the most widely accepted authority on this point, taking the formula of cellulose as $C_{24}H_{40}O_{20}$ we may have the following:

Cellulose Nitrates	Percent of Nitrogen	Weight obtained from 100 parts of Cellulose
Cellulose endecanitrate..	13.47	176.4
Cellulose decanitrate....	12.75	169.4
Cellulose enneanitrate...	11.96	162.5
Cellulose octonitrate....	11.11	155.7
Cellulose heptanitrate...	10.18	148.6
Cellulose hexanitrate....	9.15	141.7
Cellulose pentanitrate...	8.02	134.7
Cellulose tetranitrate....	6.76	127.8

There are probably existing also isomers of many of the nitrates given in the table. Following their differences in composition these different cellulose nitrates have different properties especially as regards their solubility in organic solvents. Thus all except the endecanitrate, if properly made, are soluble at ordinary temperatures in a mixture of one volume of alcohol and two volumes of ether. Such cellulose nitrates are called *pyroxyline*, *nitrocotton*, *soluble guncotton*, and *collodion*, *cotton* or *guncotton*. The decanitrate is also called *pyrocellulose*. All the cellulose nitrates are by some called *nitrocellulose*. The material produced by the Abel process described above is partly soluble, but mostly insoluble in the ether-alcohol mixture, and to this material the name *guncotton* or better *military guncotton* is applied. In addition to guncotton, the cellulose nitrates are used in the manufacture of smokeless powder, explosive gelatine, pyroxylin plastics, pyroxylin varnishes, photographic films and collodion. For smokeless powders and explosive gelatine the deca- and enneanitrates are most largely used. For varnishes, collodion and photographic films the octonitrate is generally employed. And the heptanitrate, which is of low nitration, is preferred for the pyroxylin plastics. This last nitrate may be made by dipping one pound of pure dry cotton or tissue paper in 100 pounds of a mixture of 66 parts of sulphuric acid, 17 parts of nitric acid and 17 parts of water, and continuing the immersion at 30° C. for 20 to 30 minutes. The acid is then wrung out and the nitrate washed and neutralized. The higher nitrates are made by using stronger acids, longer exposures and higher temperatures. In making pyroxyline varnishes, which are largely used in coating metals, artificial leather and in waterproofing, the pyroxylin is dissolved in ethyl acetate, amyl acetate and similar organic solvents.

Collodion, which is used in surgery, is made by placing 30 grams of pyroxylin in a suitable bottle, pouring upon it 750 cubic centimetres of ether, corking the bottle and allowing the whole to stand 15 minutes. Two hundred and fifty cubic centimetres of alcohol are then added and the bottle shaken until the pyroxylin is dissolved. On allowing to stand the solution becomes clear, and if poured upon a flesh wound the solvents evaporate and a continuous film of pyroxylin is formed which protects the wound from the air and which also, by contracting as it dries, brings the edges of the wound together. Substances such as cantharides, tannic acid and the like, by which to produce blistering, styptic and other effects, may be added to the collodion. See EXPLOSIVES. CHARLES E. MUNROE,

The Columbian University, Washington, D. C.

Gunnery is the science and art of using guns. As a science it treats primarily of the motion of projectiles, and has three branches, "interior ballistics," "exterior ballistics," and "effects of projectiles."

"Interior ballistics" considers motion within the gun, and seeks to determine the fluid pressure caused by the combustion of a given charge of powder and the velocities thereby imparted to the projectile and to the gun itself.

From the middle of the 14th century until some 20 years ago, a practically unchanged mixture of nitre, sulphur, and charcoal, called gun-

powder, was universally used as the propelling agent in firearms. At first, as the name implies, it was used in the form of dust; later the superior effects produced by granulation were discovered, and a powder in the form of small irregular grains was used in all kinds of guns; early in the 19th century powders were divided into two classes, the finer-grained "musket powder" being used in all shoulder pieces, and the coarser "cannon powder" in all artillery; about 1860 Gen. Rodman, U. S. A., proposed and developed the manufacture of powders of regular granulation and very large grains for use in the 15- and 20-inch smooth-bore guns; with the advent of large rifled cannon, the practice became general of molding powder into separate grains of a size and density suited to the particular gun in which it was to be fired; a slower burning gunpowder, called brown, or cocoa, powder from its color, and made from underburned charcoal, next came into use for large guns; and, finally, the discovery that the high explosives can, by suitable treatment, be made to burn progressively in guns made smokeless powders practicable, and these have now entirely superseded gunpowder.

The explosion of the powder charge of a gun begins with "ignition," which is the setting on fire of a portion of it; "inflammation," or the spreading of the fire from grain to grain, throughout the charge, follows; and "combustion," or the burning of each grain from surface to centre, completes the phenomenon. Meanwhile the gaseous products of the combustion, filling the powder chamber, develop a fluid pressure which starts the projectile from its seat and gives it an accelerated motion along the bore. Evidently the gas pressure at any instant depends upon the quantity of powder consumed at that instant and the space which the products of its combustion occupy, and the latter depends not alone upon the volume of the powder chamber, but also upon the displacement of the projectile. It might well be thought that the periods of time required for the inflammation and combustion of a charge of gunpowder are so small as to be negligible, yet much of the superiority of modern over ancient ordnance comes from proper regulation of those time intervals. The ballistic power of granulated was much greater than that of dust powders because the interstitial spaces between the grains greatly increased the rapidity of inflammation, and the use of large charges of grained powders without inadmissible strains upon guns was made possible only by so diminishing the rapidity of combustion that the burning of the powder was not complete till the projectile had traversed a considerable portion of the bore of the gun. Robins, Hutton, and Count Rumford were the pioneers in the experimental determination of the force of fired gunpowder and in measuring, by means of the former's "ballistic pendulum," the velocities which it imparted to projectiles, but Rodman was the first to directly measure the pressures developed in guns by the explosion of their charges. In 1861 he published the results of experiments made for the United States government, and described his pressure gauge, a modification of which is still universally used for measuring powder pressures. The Rodman gauge consists of a piston contained in a small cylinder inserted in the gun wall so that the inner end of the piston is exposed to the bore of the gun, while its outer end, which carries a knife edge, presses against a disk of soft copper: on firing the gun the gas pressure forces the piston outward and the knife edge makes a cut in the copper which, by comparison with cuts made by known forces, measures the gas pressure which produced it. Rodman measured the pressures in guns not only at the bottom of the bore, but at intervals to the muzzle, thereby determining the necessary thickness of metal to withstand them, and he showed that by making the size of the powder grains vary with the size of guns, their ballistic power could be increased without increase of strain upon their walls.

The first exhaustive investigations of the phenomena attending the explosion of gunpowder were those of Noble and Abel, communicated to the Royal Society in 1874 and 1879. They measured velocities with the electric chronograph, and powder pressures with the Noble "crusher" gauge, which differs from the Rodman gauge in using the extent to which a copper disk is shortened by crushing, instead of the dimensions of a cut, to measure the force. They found that the products of explosion consisted of 57 per cent by weight of solid or liquid matter and of 43 per cent by weight of permanent gases; that the gases, reduced to 32° F. and atmospheric pressure, would occupy about 280 times the volume of the original powder; that the pressure produced if the powder filled the space in which it was exploded was about 43 tons per square inch; and that the temperature of combustion was about 4000° F. They also deduced formulæ for the pressure at any point in the bore of a gun and for the work per pound of powder which its charge would do, both based on the assumption that the solid and liquid residue gave up its heat to the gases during their expansion; and these formulæ were very generally used until gunpowder was replaced by smokeless powders, it being only necessary to apply to the calculated work of any powder charge a "factor of effect" based upon experience in order to predict with reasonable accuracy the muzzle energy of the projectile and thence to deduce its velocity. By far the most important and complete study of the questions of interior ballistics has been made by the engineers of the French "Service des Poudres et Salpêtres" during the past 20 years, and it is to their experimental investigations that we owe almost all of the latest knowledge upon this subject. Sarau was the first to take into account the progressive combustion of the powder charge under the varying pressure in a gun, and by assuming that the velocity of combustion is proportional to the square root of the pressure he deduced his now classic formulæ for the muzzle velocity and maximum pressure resulting from firing a given gun with any given charge of a powder of previously established characteristics. He, like all previous investigators, assumed that the powder grains burned progressively from the surface in parallel layers, but Vieille, by registering the movement of the piston of a crusher gauge while it was compressing a copper disk under the action of powder pressure, measured the rate at which the pressure was developed and, having thus determined the law of combustion of various explosives, proved that progressive burning from the surface was a

characteristic only of the modern smokeless powders and did not occur in the case of the older black and brown gunpowders in the forms in which they were actually used in guns. Vieille found that the velocity of combustion of pure guncotton smokeless powders was proportional to the two thirds power of the pressure, varying from about 1.4 inches per second under a pressure of two tons per square inch to about six inches per second under 20 tons per square inch; while in the case of smokeless powders containing from 40 per cent to 50 per cent of nitroglycerine, such as cordite and ballistite, the velocity of combustion was about three times greater and varied about as the five ninths power of the pressure. He also established the fact that the pressure caused by the combustion of any explosive in a closed chamber is accurately given by the expression $p=\frac{f\ \Delta}{1-a\ \Delta}$ in which Δ is the "density of loading" or the ratio of the weight of the explosive to the weight of water which would fill the chamber; f is the "force" of the explosive, varying from about 22 tons per square inch for gunpowder, to as much as 67 tons per square inch for some smokeless powders; and a is the "covolume" of the explosive, having a value from 0.5 to 0.6 for gunpowders and not differing greatly from unity in the case of high explosives and smokeless powders.

Notwithstanding his somewhat erroneous assumptions, Sarau's formulæ gave very accurate results for gunpowder, and when put in the slightly modified form which follows they are still the most reliable for use with smokeless powders. As originally used, Sarau's formulæ contained factors depending upon the form of the powder grain and its time of combustion in free air; but with smokeless powders these may be displaced by a single factor, namely, the "least dimension" of the grain, since with true progressive burning it is this, which, for any given powder, fixes its time of combustion.

These formulæ, as modified, are

$$V=A\frac{w^{5/8}\ u^{3/8}}{e^{1/2}\ p^{1/4}\ c^{1/4}\ s^{1/4}}\left(1-B\frac{p^{1/2}\ u^{1/2}}{e\ c}\right) \text{ and } P=K\frac{w^{7/4}\ p^{1/4}}{e\ c^{2}\ s},$$

in which V is muzzle velocity of projectile in feet per second.

u is travel of projectile in the bore, and c is the calibre, in inches.

p is weight of projectile, and w that of powder charge, in pounds.

s is volume of powder chamber, in cubic inches.

e is the least dimension of the powder grain, in inches.

P is maximum pressure in gun, in pounds per square inch.

A, B, and K are constants, having the following values as determined by experiment for the guncotton smokeless powder used in the United States:

$A=373.68$; $B=.00035133$; $K=98555$.

The following practical formulæ give approximately the changes in muzzle velocity and maximum pressure (dV and dP) due to small changes in the weight of projectile or of powder charge (dp and dw).

$$\frac{dV}{V}=-0.43\frac{dp}{p};\ \frac{dP}{P}=0.3\frac{dp}{p};\ \frac{dV}{V}=\frac{5dw}{8w};\ \frac{dP}{P}=\frac{7dw}{4w}.$$

Similarly, the change in muzzle velocity, due to a change in the length of bore, is $\frac{dV}{V}=k\frac{du}{u}$ where k has a mean value of about five sixteenths, varying from three eighths for slow to one fourth for quick powders.

Among modern practical ballistic instruments are Sébert's "projectile register" and "velocimeter." The former directly measures the acceleration of a projectile during the first part of its motion in the gun, and thus determines the pressure on its base; but the difficulty of stopping the projectile in a butt without injuring the recording apparatus contained in it has prevented the extensive use of this device. The velocimeter is an apparatus for the simultaneous registering of the time and the distance moved by a gun in free recoil, whence the pressure on the bottom of the bore is calculated.

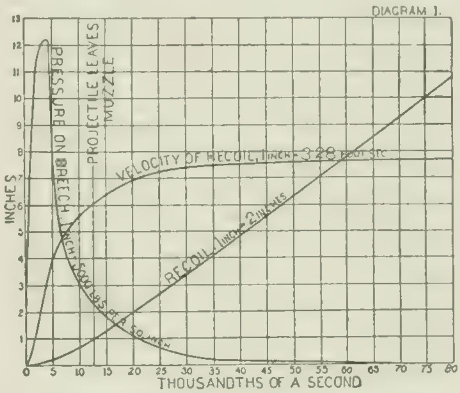
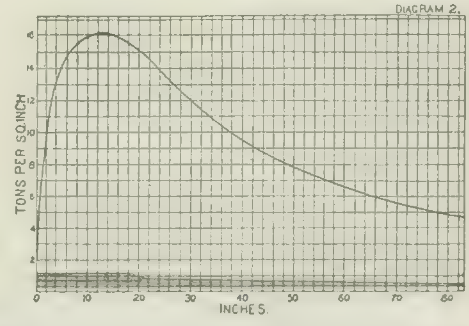


Diagram 1 gives the information obtained by means of the velocimeter from the firing of a United States army 8″ rifle. The projectile weighed 300 pounds; the charge was 52 pounds of a guncotton nitroglycerine smokeless powder; and the total recoiling weight was 34,573 pounds. The maximum pressure of 61,500 pounds per square inch was attained in .0045 seconds from the beginning of motion, and at that time the gun had moved 0.26 inches to the rear, and acquired a velocity of 10.76 f.s.; while the projectile had moved 27.54 inches and acquired a velocity of 1,140 f.s. The projectile left the muzzle in .013 seconds with a velocity of 2,072 f.s., having traveled 204.87 inches;



while at the same instant the gun had moved 1.9 inches and had a velocity of 19.78 f.s., and

the pressure had fallen to about 11,000 pounds per square inch. Spring gauges, capable of giving a continuous record of the varying pressures in a gun and registering them as the gun recoils, have also been successfully used in recent years, and diagram 2 gives the information obtained by such means from the firing of a French 10 c.m. (3.97 inches) gun. The projectile weighed 31 pounds, and the charge was 4.4 pounds of French guncotton smokeless powder. The maximum pressure of 18.6 tons per square inch was developed when the gun had moved 0.14 inches in free recoil, and the projectile 12.0 inches; when the projectile left the muzzle the gun had recoiled 0.95 inches and the pressure had fallen to about 5.3 tons per square inch.

It will be seen from diagram 1 that the velocity of recoil increases from about 20 f.s. to 25 f.s. after the projectile has left the muzzle. This is due to the reaction of the escaping powder gases. If u and W are the maximum velocity of free recoil and the total recoiling weight, p and w being the projectile and powder-charge weights, and v the muzzle velocity, then $Wu = vp + nvw$, where nv is the mean velocity of exit of the powder gases. With gunpowders n has a value of about three halves, but with smokeless powders it is probably somewhat larger.

The energy of rotation of the projectiles of modern guns is about 2 per cent of their energy of translation, and is allowed for in ballistic calculations by a suitable increase of the assumed value of the weight of the projectile. About 1 per cent of the available energy developed by the discharge is absorbed in the recoil of the gun: from 10 per cent to 12 per cent is taken up in giving energy of translation to the powder charge itself; and about 5 per cent goes to heat the gun walls.

Exterior Ballistics treats of the motion of projectiles after they have left the gun, and investigates the laws which govern their flight in air. The ancient artillerists supposed that the trajectory was composed of three distinct parts, of which the first, or "violent" part, was a straight line, the middle a circle, and the last, or "natural" part, again straight. Nicholas Tartaglia, who may well be called the father of ballistics, invented the quadrant for measuring a gun's angle of elevation, and in 1537 published a treatise on the flight of projectiles, in which he showed that no part of a trajectory is straight, and that the range increases with the angle of elevation up to 45°, where it is greatest. Galileo, who also neglected the resistance of the air, showed that the path of a projectile is a parabola with vertical axis. Newton, assuming that the resistance of the air is proportional to the square of a projectile's velocity, demonstrated that the trajectory consisted of two dissimilar branches, one ascending and the other descending, and that the latter would become vertical if sufficiently prolonged. Robins was the first to measure experimentally with any degree of accuracy the velocity of projectiles. In 1742 he published his famous 'New Principles of Gunnery,' and described his invention, the "ballistic pendulum," which consisted of a heavy bob suspended from a tripod and arranged to receive the impact of a projectile and to register the resulting swing: the velocity imparted to the bob by the impact could then be calculated, and thence, by the principle of the equality of the quantities of motion before and after the impact, the striking velocity of the projectile could be determined. Robins measured velocities as high as 1,700 f.s., and determined approximately the loss of velocity due to air resistance for distances up to 250 feet from the gun; he also suggested using the gun itself as a pendulum and calculating the velocity of the projectile by observing the swing of the gun when it was fired, and Count Rumford soon afterward experimented with this device. Dr. Hutton made extended experiments in England from 1775 to 1791 with both the ballistic pendulum and the gun pendulum, but there was no further great advance in knowledge of ballistics until the French government experiments were made at Metz in 1839 and 1840, from the results of which it became possible to roughly construct trajectories and to calculate, by empirical formulæ, approximate ranges and times of flight for any given elevation of a gun. In 1840 Wheatstone suggested measuring the velocity of a projectile by causing it to cut successive wire screens, each of which formed part of an electric circuit, and in following years many instruments for measuring projectile velocities by electricity were perfected, of which the Boulengé chronograph is to-day the most widely used. This instrument consists of two electro-magnets, the magnetizing currents of which pass through wire screens at a carefully measured distance apart in the path of the projectile, and from one of which is suspended a long cylindrical rod, called the chronometer, while from the other is suspended a shorter rod, called the registrar. A spring trigger carrying a knife edge is so arranged that when the registrar drops it strikes and releases it, causing it to fly forward and make a cut on the side of the chronometer. When released by hand the trigger makes a mark on the suspended chronometer called the origin: when the circuits are simultaneously broken by a device called the disjunctor the chronometer and registrar fall freely side by side until the released trigger makes a second mark on the chronometer at a distance above the origin called the disjunctor reading: when a projectile is fired it cuts the first screen, releasing the chronometer, then it cuts the second screen, releasing the registrar, and thus a mark is made whose distance above the origin is the velocity reading: then the time of falling freely the velocity reading less the time of falling freely the disjunctor reading is the time it took the projectile to travel from the first to the second screen, and the distance between the screens divided by this time is taken to be the velocity of the projectile when midway.

The perfection of a means of accurately measuring the velocity of a projectile at any desired point in its path made it practicable to experimentally investigate the laws governing the resistance of the air. Bashforth, in extensive experiments (1865–70 and 1878–80), showed that the resistance was proportional to the square of the projectile's diameter, and for flat, hemispherical, and ogival-shaped heads, varied in ratios about as 1.5, 1.0, and .80; his earlier experiments, however, were vitiated by his use of studded projectiles having insufficient rotation for smooth flight. Mayevski's deductions, published in 1883, and founded upon Krupp's ex-

periments, are probably the most reliable. Expressing the retardation ($\frac{dv}{dt}$) in the form $A\frac{d^2}{w}v^n$, in which d is diameter in inches, and w is weight in pounds of the projectile, v is its velocity, and $\frac{dv}{dt}$ its retardation in f.s.s., he found the following values for A and n:

v between 2800 f. s. and 1375 f. s.;	$n=2$;	log $A=$	6.119244(-10)
v " 1375 " " 1230 ";	$n=3$;	"	2.980883(-10)
v " 1230 " " 970 ";	$n=5$;	"	6.801844(-20)
v " 970 " " 790 ";	$n=3$;	"	2.773423(-10)
v " 790 " " 0 ";	$n=2$;	"	5.669876(-10)

These values of the consonants n and A are for projectiles having ogival heads of two calibres radius, and for a standard condition of the atmosphere. For other conditions the retardation found as above must be multiplied by a coefficient of form (i), and by the ratio of the actual density of the air to its assumed standard density ($\delta=\frac{\Delta 1}{\Delta 0}$). Thus we have for a general formula $\frac{dv}{dt}=i\,\delta\,A\frac{d^2}{w}v^n$, in which i depends upon the form of the projectile, and is unity for most modern projectiles, and δ depends upon the temperature, barometric height and humidity, and is unity for ordinary atmospheric conditions.

Since the retardation is inversely proportional to $\frac{w}{i\,d^2}$, that factor, which is called the "ballistic coefficient" and denoted by C, measures the "ranging power" of a projectile. With spherical projectiles C could only be increased by increasing the calibre, but with rifled guns it became possible to greatly increase its value for any calibre of gun by lengthening the projectile and sharpening its point, and it is this fact which largely accounts for the immense superiority in ballistic power of rifled over smooth-bore guns.

Assuming that the axis of a projectile coincides with the tangent to its path, as is practically the case with modern rifled guns, the resultant action of the resistance of the air will likewise coincide with the axis, and the trajectory will be the same as if the mass of the projectile were concentrated at its centre of gravity and moved under the action of two forces, one the constant vertical force of gravity w, and the other the variable resistance $\frac{w}{g}\frac{dv}{dt}=A\frac{i\,\delta\,d^2}{g}v^n$ acting in the tangent. Under these circumstances the differential equation to the trajectory is readily obtained, and, though its form prevents direct integration, its approximate solution has been effected by several different methods, of which Siacci's is the simplest and the one almost universally used. By Siacci's method the two co-ordinates, the inclination, the time, and the velocity at any point of the trajectory are given as functions of a new variable, called the pseudo-velocity, and, by means of tabulated values of those functions all the problems of exterior ballistics may be accurately solved.

As shown by Mayevski's formulæ, we may consider the air resistance to be proportional to the square of the velocity, so long as the velocity exceeds 1,375 f.s., which is the case throughout the trajectories of modern naval and coast defense guns (excepting mortars), when they are fired at the moderate elevations with which alone they are practically used. Within these limits the equation to the trajectory in air, the gun being the origin, is $y=x\tan\alpha-\frac{g\,x^2}{2V^2\cos^2\alpha}(1+\frac{2kx}{3})$, the first two terms of which represent the trajectory in vacuo, and in which α is the angle of departure of the projectile, V is its initial velocity, and k is the constant in the expression for the retardation $\frac{dv}{dt}=kv^2$. Thus, for example, taking the case of a 12″ projectile of standard form, 880 pounds weight, and 2,800 f.s. initial velocity, we have, under standard atmospheric conditions, $k=A\frac{d^2}{w}=\frac{d^2}{w}$ (6.119244 —10) = .000021534, and, supposing we wish to determine the proper angle of elevation for a range of 3,000 feet, putting $y=0$, we get $\sin 2\alpha=\frac{g\,X}{V^2}(1+\frac{2kX}{3})=0.0128$; whence $\alpha=22'$. By the same formula the elevation for a range of 15,000 feet will be found to be 2°—09′, which agrees with the published range table for the latest pattern United States naval 12-inch gun.

Representing the ratio of the range of any projectile in vacuo (P) to its range in air (X) by n, so that n is the $1+\frac{2k}{3}X$ of the preceding formula, it can be shown that n, while always greater than unity, cannot exceed 3, and that for flat trajectories the following relations are quite approximately true: the angle of fall (ω), which in vacuo equals the angle of projection (α), in air is given by $\tan\omega=(2-\frac{1}{n})\tan\alpha$; the abscissa of the highest point (X_1), which in vacuo is half the range (X), in air is given by $X_1=X\frac{\sqrt{3n^2-3n+1}-1}{3(n-1)}$ and cannot exceed $0.57X$: the time of flight (T), which in vacuo would be $T_1=\frac{X}{V\cos\alpha}$ or very closely $\frac{X}{V}$, in air is given by $T=\frac{2.(3n-2)^{\frac{3}{2}}-1}{9\quad n-1}.\frac{X}{V}$, or still more roughly by $T=n\frac{X}{V}$, and cannot exceed $1.95T_1$: the striking velocity (U), which in vacuo would be the same as the initial velocity V, in air is given by $U=\frac{V}{\sqrt{3n-2}}$ and cannot be less than $0.38V$.

Experience shows that the projectiles of rifled guns, when fired in a still atmosphere, deviate from the plane of fire (a vertical plane through the axis of the gun) to an extent approximately proportional to the square of the time of flight and in the direction toward which the upper surface of the projectile moves in its rotation. This deviation is called "drift." and fer all United States guns is to the right, since they are so

rifled that their projectiles, viewed from the rear, turn with the hands of a watch. With modern high-velocity guns drift is only important at very long ranges, being, for example, in the case of the 12-inch rifle already cited about 1½ yards at 2,000 yards range, and about 100 yards at 12,000 yards range. The cause of drift is that soon after the projectile leaves the gun the line of action of the air resistance ceases to coincide with the axis (on account of the curvature of the trajectory), and, meeting that axis obliquely between the point of the projectile and its centre of gravity, tends to raise the point, which action, combined with that of rotation, causes the point to move first to one side (the right for right-handed rotation), and then downward: this movement, by virtue of which the axis of the projectile tends to describe a cone about the tangent to the trajectory, is called precession, and its result, in combination with the angular motion of the tangent caused by the curvature of the trajectory, is to keep the point of the projectile always on that side of the plane of fire toward which it was first deflected. Thus with right-handed rifling the projectile, during its flight, always points very slightly to the right of the plane of fire, and consequently the resistance of the air has a component normal to that plane which carries the projectile bodily to the right with increasing velocity.

For many reasons, among others the fact that the drift caused by rotation is affected by lateral wind pressure, it is difficult to determine accurately the deviation of a projectile which will result from a side wind. Hélie's formula, $D = W\left(T - \frac{X}{V \cos \alpha}\right)$ in which W is the velocity component of the wind at right angles to the line of fire, T is the actual time of flight, and $\frac{X}{V \cos \alpha}$ is the time the projectile would take to traverse the range (X) if its original horizontal velocity ($V \cos \alpha$) remained unchanged, is usually relied upon; but, while reasonably accurate for light projectiles, it gives much too great results for modern projectiles of large calibre, especially at moderate ranges. Assuming that in the short time of flight the projectile can acquire but little lateral velocity, the wind effect is a practically constant lateral pressure, and the deviation caused by it will be $D = k \frac{W^2 T^2}{d}$ in which, d being the diameter of the projectile, W the wind velocity at right angles to the plane of fire, T the time of flight, and D the deviation, k will be a consonant whose value must be found by experiment. The increase or decrease in the range caused by the wind is approximately $\Delta X = 2 W T \left(\frac{VT}{X} - 1\right)$, in which W is the velocity component of the wind in the plane of fire.

The Effects of Projectiles depend not only upon their own characteristics, but also upon the nature of the objects attacked. "Cannister," the balls of which spread on leaving the gun and rapidly lose their velocity, are only effective at ranges within 300 or 400 yards and against exposed men or very light vessels, such as torpedo boats. The "shrapnel," burst by the action of a time fuse, produces a cone of balls and fragments whose axis is the trajectory and whose angle of dispersion depends upon the violence of the explosion, and can be used effectively against exposed men at any range, provided the point of burst can be properly adjusted: with field artillery, which uses shrapnel almost exclusively, it is usual to adjust the fuses with a view to causing the burst to occur when the height of the shrapnel above the point of attack is about one two hundredth of its distance from the gun. "Common shell" are sometimes used like shrapnel, but as a rule they are fitted with percussion fuses to cause them to explode on impact, in which case they are effective against unarmored ships and fortifications, and against any structures not protected by armor sufficiently thick to cause them to break up without penetration. If made of steel, and with thick walls, a common shell may be capable of penetrating steel plating of a thickness equal to half its own calibre, but as a rule the shell walls are thin and the power of penetration much less than this. It requires a resistance at least equal to that of a quarter-inch steel plate to actuate the fuse of a 6″ shell, and after penetrating such a plate it will range 10 or 15 feet before bursting. The larger the shell the more the resistance required to burst it, and the farther it travels after impact before bursting. From the point of burst the fragments spread in a cone, the angle of dispersion depending upon the relation between the velocity of the shell as a whole at the instant of bursting and the velocity imparted to the fragments by the explosion. The greater destructive effect of shell loaded with high explosives than of those loaded with gunpowder is primarily due to the much wider angle of dispersion of the former. "Armor-piercing shell" have been so perfected as to be capable of penetrating, unbroken and undistorted, a thickness of wrought iron or steel only limited by their striking energies. Against hard-faced armor, however, these projectiles require the aid of soft steel caps in order to penetrate even a moderate thickness without being shattered. The formulæ of Jacob de Marre, based upon French experiments, are considered the most reliable for calculating the velocity necessary for the perforation of oak, wrought iron, or homogeneous steel by projectiles of the usual form and of such quality as not to be broken or seriously distorted by the impact. When a projectile is distorted, or is broken, by impact, the velocity necessary for perforation increases very rapidly with the amount of distortion, or the number of fragments.

These formulæ are as follows:

For oak $v = \frac{e^{.6}\, a^{.9}}{p^{.5}}$ (log 2.20987)

For wrought iron $v = \frac{e^{.65}\, a^{.75}}{p^{.5}}$ (log 2.96162)

For steel $v = \frac{e^{.7}\, a^{.75}}{p^{.5}}$ (log 3.00941)

In which e is the thickness to be perforated and a the diameter of the projectile, both in inches; p is weight of the projectile, in pounds; and v is its striking velocity in feet per second.

For capped projectiles and Harveyized armor, the Davis formula, based upon experiments at the United States naval proving ground, is $v = \frac{e^{.8}\, a^{.5}}{p^{.5}}$ (log 3.25312), and the same formula will serve as well as any yet proposed for Krupp armor, if to the calculated velocity be added from 50 to 100 f.s., the amount added increasing with the thickness of the plate.

The above formulæ are all for normal impact. When the angle which the axis of the projectile makes with a normal to the plate is less than 30°, provided the projectile remains whole, and if its velocity component normal to the plate exceeds the velocity required for perforation with normal impact, it will perforate the plate: with greater angles of incidence than 30° the projectile is deflected unless it very greatly overmatches the plate.

Experiments show that a projectile which will penetrate a distance unity into oak will penetrate slightly less than one half into concrete, about one half into good masonry, about three halves into sand, about four into common earth, and about seven into clay.

The Art of Gunnery is concerned with the actual use of guns, and primarily with pointing them so that when fired their projectiles shall hit the target. If a great number of rounds be fired from a gun under as nearly as practicable the same conditions, and the impacts are received upon a vertical screen, the average of their distances above or below the mean point of impact is called the mean vertical error of the gun; their average distance to right or left of the mean point of impact is called the mean horizontal error; and the trajectory from gun to mean point of impact is called the mean trajectory. Theory, as well as practical experience, indicates that only about 2 per cent of the projectiles fired will deviate from the centre of impact more than three times the mean error, and with modern guns the mean errors are so small that we may reasonably expect practically all the shots fired on any occasion, from a stationary platform, and at a fixed angle of elevation, to strike within a vertical rectangle 9 feet high by 6 feet wide at a distance of 2,000 yards. It is only necessary, therefore, to point a gun so that its mean trajectory intersects the target at the latter's centre in order to obtain a large percentage of hits: the accomplishment of this, however, is not easy and constitutes the principal part of the gunner's art. Guns are pointed by directing what is called the "line of sight" at the target. Originally the upper surface of the gun itself was used as the line of sight: this was called "sighting by the line of metal," and resulted in the gun having an elevation corresponding to the difference in thickness of the metal at breech and at muzzle, which elevation determined the range. Later a piece of wood or metal, called a dispart, was secured to the muzzle so as to give a line from breech to muzzle parallel to the gun's axis: such a line of sight had to be directed more or less above the target according to the range. Early in the last century the present method of having one fixed and one movable sight, so that the line between them, which is the line of sight, can be adjusted at any desired angle with the axis of the gun, came into use. It is customary to make the rear sight the movable one, and to put range marks on it so that if, for example, it is set at the mark 2,000 yards, the angle between the line of sight and the axis of the gun is the angle of elevation necessary to give the projectile a range of 2,000 yards. Besides the movement of the rear sight up or down, to insure the gun's having proper elevation, it is also usual to have means of moving it sidewise, so that the line of sight can be adjusted to make any desired small angle, in the horizontal plane, with the axis of the gun, and thus the drift of the projectile may be allowed for by causing the gun to point the proper amount to one side of the target at which the line of sight is directed.

If now gun and target are stationary, if there is no wind, if the air is of standard density, if the sight is set for the correct distance of the target, and so as to compensate for the drift at that distance, and if the line of sight is accurately pointed at the centre of the target, then the mean trajectory will pass through that centre and the chance of hitting will be a maximum. The first difficulty is that the line of sight cannot be accurately directed, since to do so requires the eye to determine when three objects at different distances (rear sight, front sight and target) are exactly in line; with the telescope sights now coming into general use this source of error is practically eliminated. In the next place the distance is never exactly known; there is always some movement of the atmosphere; the density of the air may readily be as much as 9 per cent greater or less than on the average; the target is usually in motion; and in the case of naval guns the gun is always in motion. The skill of the gunner, then, consists, first, in estimating the total lateral deviation which will result from wind and motion of gun and target at right angles to the plane of fire, and pointing sufficiently to one side of the target to compensate therefor; and second, in so adjusting the elevation of his gun as to compensate for the vertical deviation due to wind and motion of target in the line of fire, to angular motion of the gun if such exists, and to abnormal air resistance. With modern guns, mounted on shore, where the platform is stationary and the distance of the target can be measured with comparative accuracy, the percentage of hits upon a target of ordinary size should be very large, even at long range, if the gunners are well practised. Under the conditions of naval actions it is not surprising that in the past the percentages of hits have been extremely small, and it is not to be expected that they will ever be large, at least during such parts of actions as are fought at long range.

PHILIP R. ALGER,
U. S. Naval Academy, Annapolis.

Gun'nison, a river of Colorado which rises in Cochetopa Hills, Saguache County, flows north to Parlin, then west to Gunnison, near Cimarron enters the Grand Cañon of the Gunnison 15 miles long, and continuing in a northwesterly direction past Delta unites with the Grand River at Grand Junction after a course of nearly 200 miles.

Gunny, a jute (see JUTE) cloth, also a bag or sack. Gunny-bags are very largely exported from India to various parts of the world. American cotton is largely packed in these. They can be manufactured at a low price, hence the great demand for them. The name gunny is applied to the cloth as well as to the made-up bags. About 1850 the peasant hand-looms of Lower Bengal met both the home and the foreign demand for Indian-made gunny-bags — indeed the making of these was then the great domestic industry of that portion of India. At the present time the number made at the great steam-factories, of which there are now 23 in India, far exceeds what is produced

by hand-looms. For example, in one year 82,-779,207 gunny-bags were exported from India, of which only 5,000,000 were woven by hand.

Gunpowder, an explosive substance formed by mixing saltpeter, charcoal and sulphur together. The mixture may vary in composition between quite wide limits, and yet possess explosive properties; but the proportions adopted by the United States governmental authorities are saltpeter, 75 per cent; charcoal, 15 per cent; and sulphur, 10 per cent. The saltpeter used is the India saltpeter or niter, which is known to chemists as potassium nitrate, and although found native as an incrustation on the soil in India it is to-day largely made from Chile saltpeter, or sodium nitrate, by reacting on the latter with potassium nitrate. It is carefully purified, finely ground and thoroughly dried for use, in the manufacture of gunpowder. The charcoal most suitable for gunpowder is that variety which is mostly readily ignited, most quickly burned and gives the least quantity of ash. Such charcoal is produced from dogwood, willow or alder, by heating the air-dried woods in closed iron cylinders or retorts out of contact with air so that they undergo destructive distillation and leave the charcoal as a residue, this method of manufacture having been invented in England by Bishop Landloff and adopted in that country in 1797. The dogwood, which is really the alder-buckthorn, *Rhamnus Frangula,* is cut when one inch in diameter; the willow and alder when four inches; though these dimensions vary in practice. The wood is cut in the spring when in full sap, stripped of its bark and seasoned by an exposure of two to three years; the dogwood being stacked under shelter, but the other woods in the open so that the rain may wash the sap from the wood and the sun's rays and the air may destroy the spiral cells. The charring is effected by fires outside the retorts or by passing superheated steam or hot carbon dioxide gas through the retorts. The character and yield of the charcoal produced varies with the temperature to which the wood is exposed and the time of exposure. When the wood is heated to 290° C. red charcoal is formed; when heated to 350° C. or above, black charcoal is produced. When the heating is done quickly the yield of charcoal is much larger than when the heating is slow. Red charcoal is much more easily ignited and burns faster than black charcoal. Charcoal for the manufacture of gunpowder is ground to a fine powder by rotation in a drum with a quantity of brass or bronze balls. Sulphur of commerce is purified for use in this manufacture by fusion and distillation; being eventually obtained in the form of roll brimstone, which is then crushed to a fine powder by heavy rollers. It must be free from sulphuric and sulphurous acids, as well as solid impurities, and should consist entirely of that modification of sulphur which is completely soluble in carbon disulphide.

The dry, finely ground and sifted saltpeter, charcoal and sulphur are weighed into the mixing machine, which consists of a gun-metal drum arranged to make 40 revolutions a minute and provided with hollow bearings through which a shaft is passed which carries 44 arms or fliers of such length as to just clear the interior surface of the drum. This shaft revolves in an opposite direction to and with twice the speed of the drum. After the ingredients are put in the drum the mixing is carried on for five minutes and then the mixture goes to the incorporating or wheel mill. The process of incorporation is of the greatest importance in this manufacture. It consists in the long continued grinding together of the ingredients in order to mix them so intimately that the product appears to the naked eye as a homogeneous mass, for, unless this be done, complete reaction between the components of the powder by combustion cannot be expected. The finished gunpowder depends for its excellence largely upon the completeness and thoroughness of the incorporation. The incorporating mill consists of a circular bed of iron or stone on which the mixture is placed. A vertical shaft rising through the centre of this bed carries a horizontal one, on the two ends of which heavy stone or iron wheels, called edge runners, are hung. These wheels rotate about the horizontal shaft and, as the vertical shaft revolves, they travel at the same time in a circle around the bed so that, at the points on the bed where the edge runners touch, the motions of rotation and translation are converted into a twisting motion, like that of a muller, and the material beneath is thus overturned and very intimately mixed. The edge runners weigh from three to seven tons, are from four to seven feet in diameter, and are so movable on the spindle that they can accommodate themselves to varying thicknesses of powder on the bed. One of the edge runners is a little nearer the vertical shaft than the other, so that they travel in different paths and they are followed by a scraper which throws toward the centre of the bed the material that has been forced to the exterior by the edge runners. To incorporate, 50 pounds of the mixture are spread out on the mill-bed and slightly moistened and the wheels are set in motion. If the wheels are of stone weighing 3½ tons and making 7½ revolutions per minute, the incorporation is completed in 3½ hours. If the wheels are of iron weighing 4 tons and making 8 revolutions per minute, 2½ hours are required for cannon powder. The operator does not remain constantly in the mill but goes in occasionally to wet the charge, from 2 to 10 pints of water being used in accordance with the weather. The chief danger from accidental explosions during the manufacture of gunpowder is found in the incorporating mills; fortunately there is less explosive material here at any time than there is at any other part of the works. To render the damage done by an explosion as slight as possible, the buildings in which these operations are conducted are built with a strong framework covered with light boards, or else with three sides of stone and the fourth and roof of light wood, so that when an explosion occurs the framework or the stone walls remain. These mills are usually built in groups, and to prevent an explosion in one being communicated to the others, each is provided with a drenching apparatus which automatically wets and protects the charges in the mills adjacent to the one which is blown up. The communication of fire or explosion is also arrested by means of barricades built about the mills which consist of masonry filled with earth, or simple earth mounds or sometimes wooden structures built in the shape of a letter A.

When the incorporation is completed the mill cake, as the mixture is now called, is removed from the bed and runners by means of a copper chisel and wooden mallet. It is partly in the form of a compact cake and partly fine meal and in this condition it is put into the press. This is a powerful hydraulic press with a rectangular box which is divided into compartments of the desired width by means of copper or gun-metal plates. When the spaces between the plates have been filled with mill cake, pressure is applied which causes the particles to cohere, and the gunpowder is taken from the press in sheets having an area equal to that of the plates and a thickness dependent on the width of the filling space, the amount of the pressure applied and the duration of its application. Sometimes the press plates are corrugated like waffle irons, as for instance, in the manufacture of waffle and of hexagonal powders, and sometimes they are replaced by a press block filled with molds in each of which a separate grain is pressed, as in the manufacture of cocoa or prismatic powder. The operation of pressing is a most important one, since the density of the finished powder depends upon it and, as it is markedly affected by even slight changes in atmospheric conditions, it is a very nice one.

The press cake passes to the corning or granulating machine, where it is cut into grains. This machine consists of a hopper into which the charge is fed, an elevating band, an endless revolving table, four pairs of rollers and several sets of screens for sorting the grains according to size into boxes placed to receive each different size. The rollers, which are of gun-metal, are corrugated or provided with teeth, the upper two being coarser than the lower, and they are adjusted to the size of grain required. When the hopper has been emptied a clutch is relieved which stops the machine and at the same time rings a bell which notifies the operator of the fact for, as the machine is self-feeding, the workmen are not obliged to be present while it is at work. The grains are now freed from dust by passing through horizontal cylindrical sieves such as are used in flour-mills and they are then glazed by rotation in wooden barrels where, by the friction of the grains against each other, their angles are rounded off and a hard polished surface is imparted to them whereby they become better able to bear transportation and are less likely to absorb moisture. Sometimes the grains are coated with graphite which is put in the glazing barrel with them. Though but 4 ounces of graphite are used to 1,200 pounds of gunpowder it is considered objectionable for use with fine grain regulation powder as it delays ignition and fouls the piece, yet it improves powder to be used in fixed ammunition, in that it enables the grains to readily pack close together. As more dust is formed during the glazing process the grains are again put through the dusting reels and are then exposed for a day in the drying house to a temperature of from 125° to 130° F. The finished powder is packed in 1-pound tins or 25-pound kegs, though other sized packages are produced to some extent. According to the size or form or structure of the grains gunpowder is known as *mealed powder, superfine*, designated by the mark *F.F.G.; fine grain, F.G.; large or coarse grain, L.G.; large grain for rifles, R.L.G.; mammoth, pebble, pellet, cubical, hexagonal, spherohexagonal, waffle, Fassano* or *progressive,* and *cocoa* or *brown prismatic powder.* Mealed powder is in the form of dust and is used for driving fuses for ammunition and in pyrotechny. Fassano or progressive powder is formed by pressing mill cake to a density of 1.79, then breaking this press cake into ⅛ to ¼ inch grains, mixing these grains with a prescribed quantity of fine grain powder, pressing this mixture to a mean density of 1.76 and breaking this press cake into grains about 2½ inches square by 1¾ inches thick. By this means a grain of varying density was obtained which burned progressively. This feature was introduced into powder-making by Prof. R. Ogden Doremus of New York, but was developed in Europe. Cocoa or brown prismatic powder is the final stage of development of the compressed perforated grain invented by Gen. Rodman of the United States army. In experimenting with the 15-inch and 20-inch smooth-bore guns invented by him, Gen. Rodman found that he could reduce the initial pressures, while securing the desired velocities, by using perforated disks of compressed powder which were of a diameter equal to the calibre of the gun and between 1 and 2 inches in thickness. He styled this charge a "perforated cake cartridge" and in his 'Properties of Metals for Cannon and Qualities of Cannon Powder,' published in Boston, Mass., in 1861, he mathematically demonstrated that at the beginning such disks presented the minimum of free surface to combustion but as the powder burned there was a constant enlargement of the perforations, whereby the area of surface exposed to combustion was constantly increased and that therefore the volume of evolved gases increased as the volume of the chamber, due to the travel of the projectile, increased, in consequence of which the pressure was more uniformly distributed along the bore than it had been with the granulated powders hitherto employed. Owing to difficulties in manufacture and use, Rodman later found it convenient to build up his charges with perforated hexagonal prisms of comparatively small size. The Civil War prevented the further development of this novel idea in powder-making in this country at that time, but a Russian military commission, which visited the United States during the Civil War, was so impressed by what Rodman had accomplished, that on its recommendation the manufacture was taken up and carried on in Russia on an extensive scale, and it soon spread to other countries. About 1880 Germany adopted cocoa powder, which was a brown prismatic powder with a single canal, the grains having the form of an hexagonal prism, 1 inch in height by 1.36 inches in diameter, and a density of 1.86. This powder, however, differed from ordinary gunpowder both in the kind of charcoal used and in the proportions of the components. The charcoal was underburned or red charcoal made from rye straw, and the composition was saltpeter 80.50 per cent, charcoal 16.00 per cent, sulphur 2.50 per cent, and moisture 1 per cent. Cocoa powder was so successful for use in modern high-powered rifle guns that it was sought for by all military nations and the want was met in this country by substituting for the rye straw charcoal red charcoal from wood and carbohydrates, such as sugar, and this brown prismatic powder

was used in our modern large calibre guns until displaced by smokeless powder.

Although very great care is exercised in the manufacture of gunpowder, yet there are so many opportunities for variations to occur in each of the many steps of the process that even the best powder-makers cannot regularly produce powder that will always give the same pressure and velocity in the same gun. Since, in order to ensure accuracy of fire, the successive powder charges used must possess the same ballistic properties this result is secured by proving a number of factory runs by firing trials and then mixing these together in the proportions required to produce the desired result. This process is called blending. It was practised by Benvenuto Cellini and has been in vogue ever since.

Good black gunpowder should have a perfectly uniform slate color and it should show no difference in color when crushed. If it is bluish or quite black it contains too much charcoal or is too damp, while the presence of bright points or bluish-white spots indicates that the saltpeter has effloresced. If the powder soils the hand or a sheet of paper when run over them it contains too much moisture or else meal powder. On pressing the powder in the hand it should not crackle or be easily crushed and when crushed the grains should not fall at once to dust, but should first split into angular fragments. Three different densities are determined for gunpowder, each of which furnishes valuable information. These are the gravimetric density which is the weight of a unit volume of powder grains including the air between and enclosed in them; the relative density, which is the weight of a unit volume of powder grains excluding the air between them but including that contained in the pores of the grains; and the absolute specific gravity, which is the weight of the powder exclusive of all air.

Since smokeless gunpowder has been perfected and adopted for use in guns of all calibres it has been declared that it would supersede black gunpowder altogether; yet the census of the United States for 1900 shows that there were over 25,000,000 pounds of black gunpowder made in this country in that year and the production bids fair to be large for many years to come, because in ordnance it is necessary to use a priming charge of black gunpowder with which to fire the smokeless gunpowder; because smokeless powder cannot be efficiently substituted for black gunpowder in the older forms of small arms that are widely scattered over the country; because black powder is most suitable for use in fuses and in pyrotechny; and because smokeless powder is too expensive and inferior for use in saluting.

Gunpowder was formerly used in blasting as well as for a propellent, but usually a special mixture containing as little as 60 per cent of saltpeter was prepared for this purpose. In 1857 Lamotte Dupont of Wilmington, Del., invented *blasting powder* which differs from gunpowder chiefly in that Chile saltpeter is used in place of India saltpeter. Though cruder materials are used and less care is taken the methods pursued for its manufacture are in general similar to those used for gunpowder.

CHARLES E. MUNROE,
The Columbian University, Washington, D. C.

Gunpowder Plot, a famous conspiracy formed in England in 1604 by Robert Catesby, and a small band of other Roman Catholics, who, goaded into excitement by the penal laws directed against their faith and its professors, aimed to blow up the Houses of Parliament by gunpowder 5 Nov. 1605. An anonymous letter of warning, sent to Lord Monteagle, led to the discovery of the plot, and the various conspirators were arrested and executed. Among those put to death was Guy Fawkes, who had been caught in the vault below the House of Lords with matches ready to fire the train. Since 1605 all places connected with the Houses of Lords and Commons where explosives could be stowed away are annually searched at the opening of Parliament.

Gunsaulus, gŭn-sâ'lŭs, **Frank Wakeley,** American clergyman and educator: b. Chesterville, Ohio, 1 Jan. 1856. He was graduated at the Ohio Wesleyan University in 1875, was ordained to the Methodist ministry, but became a Congregationalist. He was pastor of Congregational Churches at Columbus, Ohio (1879–81), Newtonville, Mass. (1881–5), and Baltimore, Md. (1885–7). In 1887 he became pastor of Plymouth Church, Chicago, and from 1899 of the Central Church of that city. For some years he was also president of the Armour Institute of Technology, Chicago, resigning in 1901. He is well known as a platform lecturer, and has published: ‹Monk and Knight› (1891); ‹Phidias› (1893); ‹Gladstone› (1898); ‹The Man of Galilee› (1899), and other works.

Gunshot Wounds are wounds caused by missiles projected from firearms by the explosion of gunpowder, etc. Such wounds present great diversity of form, depending on the kind of missile. All show more or less contusion and laceration of the tissue, particularly beneath the surface. Of the two wounds usually caused, that of entrance and that of exit of the missile, the latter is usually the larger. Deflection of the missile from the straight line by hard tissue is common. Thus a ball striking the front of the chest may pass around the ribs, emerging at the back. Infection of the bullet itself, particularly when driven at high speed, is not common; and as the presence of a bullet in the body is not of itself dangerous, the error of much probing along the track is evident. A bullet readily located (the X-rays are now largely used for this purpose) is ordinarily extracted, and where signs of infection become evident the conversion of the punctured wound into a free large open wound is necessary.

Gun'ter, Archibald Clavering, American author: b. Liverpool, England, 25 Oct. 1847. He was a mining and civil engineer in the West from 1867 until 1875, when he became a stock broker at San Francisco. In 1878 he removed to New York, where he devoted himself to writing plays and novels. The best known of the former are: ‹Courage›; ‹Prince Karl›; and ‹The Deacon's Daughter.› His works of fiction, sensational volumes, largely without literary merit, include: ‹Mr. Barnes of New York› (1887); and ‹Mr. Potter of Texas› (1888); both successfully dramatized; ‹That Frenchman› (1889); ‹Miss Nobody of Nowhere› (1890); ‹Baron Montez of Panama and Paris› (1893); and ‹Adrienne de Portalis› (1900).

Günther, gün'tĕr, **Siegmund,** German geographer and mathematician: b. Nuremberg 6 Feb. 1848. Educated at several German universities he became professor of geography in the School of Technology at Munich, in 1886. Among his many valuable professional works may be named 'Lehrbuch der Determinatentheorie' (1875); 'Parabolische Logarithmen und parabolische Trigonometrie' (1882); 'Die Meteorologie ihrem neuesten Standpunkt gemäss dargestellt' (1889); 'Lehrbuch der physikalischen Geographie' (1891).

Gun'ton, George, American economist: b. Cambridgeshire, Eng., 8 Sept. 1845. He came to the United States in 1874, and until 1880 was a writer on economic subjects. He then turned his attention to sociological and economic work, and in 1890 became president of the Institute of Social Economics and editor of the 'Social Economist,' which in 1896 became 'Gunton's Magazine.' His publications include 'Wealth and Progress' (1887); 'Principles of Social Economics' (1891); 'Trusts and the Public' (1899).

Guntown, Battle of. After Gen. Forrest's capture of Fort Pillow, 12 April 1864, Gen. Sturgis was ordered to march from Memphis to intercept him, but before the expedition got fairly under way it was ascertained that Forrest had fallen back to northern Mississippi. On 1 June Sturgis started from White's Station, near Memphis, with about 5,500 infantry and artillery, under Col. McMillan, and 3,400 cavalry, under Gen. Grierson, to defeat Forrest and prevent his interference with Sherman's advance on Atlanta. Moving southward, Sturgis reached Ripley, 80 miles from Memphis, on the 8th, and on the 10th struck the Mobile & Ohio Railroad near Guntown, Miss., where Grierson, in advance with the cavalry, met Forrest's cavalry near Brice's Cross-roads, and became immediately engaged. Sturgis, who was six miles in rear with the infantry, moved on the double-quick, followed by a train of 250 wagons and, coming to where Grierson was engaged, without giving his exhausted men a moment's rest, and badly handling them, threw them into the fight. In three hours' time Forrest routed him, drove him from the field in confusion, captured prisoners, guns, and wagons, and closely pursued him to near Ripley. There, early on the morning of the 11th, his rear-guard, taking advantage of a small stream, after a sharp fight checked Forrest, and Sturgis continued his retreat to Memphis, having lost 23 officers and 594 men killed and wounded, 1,623 prisoners, 14 guns, and his entire train of 250 wagons, with 10 days' rations and a large supply of ammunition. Forrest's engaging force did not exceed 4,000 men; his loss was 492 killed and wounded. Consult: 'Official Records,' Vol. XXXIX.

E. A. Carman.

Gur'don, Lady Eveline Camilla Wallop, English writer: d. 1894. She was the second daughter of the fifth Earl of Portsmouth, and was married to Sir William Gurdon in 1888. Her contributions to periodicals were collected after her death in a volume entitled 'Suffolk Tales' (1896), in certain respects one of the most noteworthy English collections of short stories, both as regards style and sympathetic treatment.

Gurhwal, gŭr-wäl', India. See Garhwal.

Gurjun (gėr'jŭn) **Balsam,** or **Wood Oil,** the juice or liquid of the *Dipteraceæ* which grow in the Andaman Islands. It resembles copaiba balsam, and has at various times been sold as such. Its chief use in the East is as a varnish for boats and for preventing the attacks of ants on timber. It was used for the checking and alleviating of leprosy by the late Father Damien among the lepers of Molokai, in Hawaii.

Gurkhas, goor'kaz. See Ghurkas.

Gurko, goor'kō, **Ossip Vladimirovitch,** Russian soldier: b. 15 Nov. 1828; d. 28 Jan. 1901. He took part as captain in the Crimean war and as lieutenant-general commanded the Russian advance-corps which at the beginning of the war with Turkey crossed the Danube and seized Tirnova (July 1877). In the same year he captured Gorny Dubnik and Telish, and on 15–17 Jan. 1878 defeated Suleiman Pasha at Philippopolis. He was governor-general of St. Petersburg in 1879–80, of Poland in 1883–94, and in 1894 was retired with field-marshal's rank. He was among the foremost Russian generals of recent times.

Gurnards, gėr'nardz, a family of teleost fishes (*Triglidæ*) occurring in all warmer seas, resembling somewhat the sculpins in the rough spiny bones of the skull, but differing in having the body regularly scaled or covered with bony plates. The fantastic sea-robins (*Prionotus*) are common representatives on our coasts. Closely allied are the flying-gurnards (family *Cephalacanthidæ*) of the warmer seas, in which the pectoral fins are very long, enabling the fish to flutter a short distance in the air.

Gurney, gėr'nĭ, Sir **Goldsworthy,** English inventor: b. Cornwall, England, 1793; d. 1875. He built a steam carriage in 1827, and was the first to devise and use the high-pressure steam-jet in locomotion. He invented the oxyhydrogen blow-pipe, and the Drummond light.

Gurney, Joseph John, English Quaker philanthropist: b. Earlham Hall, near Norwich, England, 2 Aug. 1788; d. there 4 Jan. 1847. He was a banker in Norwich and in 1818 became a preacher in the Society of Friends, and the same year accompanied his sister, Mrs. Elizabeth Fry (q.v.), on her tour to Scotland, having warmly taken up the benevolent cause to which she had devoted herself — the amelioration of the condition of prisoners. In 1827 the two made a journey to Ireland with the same object, and in 1837 Gurney visited the United States and Canada, where he was absent for nearly three years. He went with Mrs. Fry in 1841 to Holland, Belgium, and Germany, and in 1842–4 visited France and Switzerland. The object of these journeys was to reform prison management, and effect the abolition of slavery in the French colonies, for which purpose he had interviews with Louis Philippe and M. Guizot. He was the author of 'Notes on Prisons and Prison Discipline' (1819); 'Observations on the Religious Peculiarities of the Society of Friends' (1824); 'Essays on the Evidences, Doctrines, and Practical Operation of Christianity' (1827); 'Winter in the West Indies Described in Familiar Letters to Henry Clay of Kentucky' (1840).

Gurowski, goo-rôf'skē, **Adam de,** Count, a Polish scholar and author: b. Kalisz 10 Sept.

1805; d. Washington, D. C., 4 May 1866. In early life he was a leading Polish patriot, and an instigator of the revolution of 1830. Later he became an advocate of Panslavism, and was employed in Russia. In 1841 he left the latter country and in 1849 came to the United States, and from 1861 to 1863 was a translator in the State Department at Washington. Among his works, several of which were written in French and German, are: 'Civilization and Russia' (1840); 'Panslavism' (1848); 'Russia as It Is' (1854); 'The Turkish Question' (1854); 'America and Europe' (1857); 'My Diary: Notes on the Civil War' (1862–6).

Gur'teen, Stephen Henry Villiers, American Protestant Episcopal clergyman and sociologist: b. near Canterbury, England, 9 June 1840; d. 1898. He was educated at Jesus College, Cambridge, and was ordained in 1875. He was professor of Latin at Hobart College, Geneva, N. Y., was successively rector of Trinity Church, Buffalo, and Trinity Church, Toledo, Ohio, and dean of St. Paul's Cathedral in Springfield, Ill. He interested himself in charity organization, and was instrumental in forming the Order of Associated Charities. He wrote: 'Phases of Charity' (1877); 'Provident Schemes' (1879); 'What is Charity Organization?' (1879); 'Handbook of Charity Organization' (1882); 'How Paupers are Made' (1883); 'Beginnings of Charity Organization in the United States' (1894).

Güssfeldt, Paul, powl güs'fĕlt, German explorer: b. Berlin 14 Oct. 1840. He studied science and mathematics between 1859 and 1865 in Heidelberg, Giessen, and Bonn. The German African Company sent him out on an expedition in 1872 to explore the Loango coast. He was shipwrecked near Freetown (14 Jan. 1873), and landed at the mouth of the Kongo. He has given an account of this expedition in the work 'The Loango Expedition' (1879), which he wrote in collaboration with his fellow travelers Falkenstein and Pechuel-Loesche. In 1876 he explored the Arabian Desert, and in September 1882 he visited South America. Among the Andes he discovered a vast area of glaciers, in lon. 34° 30′ S. He climbed the highest peak of the volcanic range of the Andes (21 Feb. 1882) and reached the edge of the crater of Maipó, and during April and May of the same year explored the lofty plateaus of Bolivia. He has published 'In den Hochalpen' (1893); 'Reise in den Anden von Chile und Argentinien' (1887); 'Der Mont Blanc' (1894).

Gustavus (gŭs-tā'vŭs) **I.** (commonly called Gustavus Vasa), king of Sweden: b. Lindholmen 12 May 1496; d. Stockholm 29 Sept. 1560. He studied at the University of Upsala, and entered the service of Sten Sture the younger, administrator of the kingdom, in 1514. Sweden had, by the union of Calmar, become subject with Norway to the crown of Denmark. The country was at this time divided into two parties. There was a Danish party headed by the Archbishop of Upsala, and a Swedish party, which upheld the independence of the country, headed by the administrator whom it had raised to power. Gustavus fought with distinction under Sture against the Danes in 1517 and 1518. He was one of six hostages sent by Sture as guarantee of the safety of King Christian II., but effected his escape, and reached Lübeck in 1519. After wandering about for some time as a proscribed fugitive he took refuge in the mines of Dalecarlia, where he worked as a common laborer. After various adventures he attempted open resistance. Christian II. was crowned at Stockholm on 4 Nov. 1520. On the 8th the leaders of the Swedish party, among whom was Gustavus' father, were executed. By the beginning of 1521 Gustavus had raised a considerable force, driven the Danes from several positions, and excited a general insurrection in Dalecarlia. In April he defeated the Danes at Westeraas; in July he seized Upsala, and in August was named administrator of the kingdom by the states which had assembled at Wadstena. On 6 June 1523 he was elected king by the Diet of Strengnäs. In 1527 he obtained the exclusion of the bishops from the senate, and their subjection to the civil power. He now openly professed Lutheranism, and was crowned by a Protestant archbishop of Upsala on 12 Jan. 1528. The Lutheran religion was formally established at a diet held at Orebro in 1529. In 1544 the states assembled at Westeraas declared the kingdom hereditary in his house. A war broke out with Russia in 1555, which was concluded by the Peace of Moscow, 2 April 1557.

Gustavus II. (Gustavus Adolphus), king of Sweden, grandson of Gustavus Vasa: b. Stockholm 9 Dec. 1594; d. Lützen, Saxony, 16 Nov. 1632. He was trained to war under experienced generals, and at 16 took his place in the state council. Charles IX., the father of Gustavus, had been declared king to the exclusion of his nephew Sigismund, who, on accepting the crown of Poland during his father's lifetime, had abjured the Protestant religion. On the death of Charles, Gustavus succeeded him, with the consent of the states, as king-elect. Sweden was at this time at war with Denmark, and Gustavus was in command of the army. He chose for his chancellor and first councillor Axel Oxenstiern, a man 10 years his senior, and already eminent for his ability, who eventually proved himself to be one of the greatest of European statesmen. The war with Denmark was concluded through the mediation of England in 1613. A new enterprise at this time presented itself to the ambition of Gustavus — the throne of Russia was vacant and contested. A party favored the election of Charles Philip, the brother of Gustavus, and was supported by a Swedish invasion under Gen. de la Gartie, who had penetrated to Novgorod; while the Poles, who had also invaded Russia, had reached Moscow. Michael Romanoff was, however, elected czar. Gustavus took a personal share in the Russian war, which continued for about four years after this election, and had made considerable conquests in Livonia and the neighboring provinces when peace was concluded at Stolbova in 1617. In 1620 he married Eleanora, sister of the elector of Brandenburg. The war with Russia was followed by war with Poland, which lasted nine years, and was concluded on advantageous terms for Gustavus by a six years' truce in September 1629. He had made important conquests, which he was allowed to retain, in East Prussia.

His attention was now diverted from northern wars by the affairs of Germany. The oppression of the Protestants by Ferdinand II.

excited his sympathy. He was alarmed by the progress of Wallenstein, which threatened to extend the empire to the Baltic, and by leaguing himself with the Protestants of Germany he might hope for easier and more extensive conquests than by struggling single-handed against the northern powers. He named his daughter Christina heiress to the throne, embarked for Germany in May 1630, and landed with an army of 13,000 men in the island of Usedom on the coast of Pomerania. (See THIRTY YEARS' WAR.) After repeatedly defeating the imperial generals, and conquering a great part of Germany, he was killed in the battle of Lützen. Gustavus differed from some other great commanders in preferring a small well-ordered army to a large one, asserting that all over 40,000 men were an encumbrance. His character made him beloved by his soldiers, and he was served with a devotion which enabled him to effect great things with small means. The discipline he imparted to the Swedish army, and the prestige of success derived from his victories, lasted long after his death. His body was taken to Sweden. See Droysen, 'Gustav Adolf' (1879); Stevens, 'History of Gustavus Adolphus' (1885); Fletcher, 'Gustavus Adolphus' (1891); Dodge, 'Gustavus Adolphus' (1896).

Gustavus III., king of Sweden: b. Stockholm 24 Jan. 1746; d. there 29 March 1792. He was the eldest son of Adolphus Frederick, duke of Holstein, who had been called to the Swedish crown in 1743, and succeeded his father on 12 Feb. 1771. He found the country divided between two aristocratic factions, the adherents of France and Russia, known respectively as the Hats and Caps. He resolved to give the country a new constitution, and to increase the power of the crown. He instituted a new military order of Vasa, in order to gain the goodwill of the officers; and effected his purpose by means of a sham revolt, which enabled him to assemble troops, wherewith he surrounded the assembly of the states-general, and forced them to accept his constitution, which, as it only circumscribed the privileges of the nobility, was generally popular. In 1788, when war had broken out with Russia, the nobles revenged themselves by inducing the states-general to refuse himself supplies. The fidelity of the Dalecarlians enabled him to repulse the enemy. To free himself from the hostility of the nobles he determined on another *coup d'état*, which he executed on 3 April 1789, by causing the leaders of the opposition to be arrested, and then passing a law extending the royal prerogative. He concluded peace with Russia by the Treaty of Varela in August 1790. The Swedes were opposed to an alliance with Russia, and a diet which Gustavus assembled at Gefle for the purpose of procuring supplies, though surrounded with troops, proved so refractory that he was obliged to dismiss it. The nobles long before this had formed a conspiracy against him, and resolved on his death. Three of them took an oath to murder him, and drew lots which should carry out their intention. The lot fell on Captain Ankarström, who shot the king in the back at a masquerade given at the opera house at Stockholm, 16 March 1792. See Bain, 'Gustavus III. and his Contemporaries' (1895).

Gustavus IV., Adolphus, king of Sweden: b. 1 Nov. 1778; d. Saint Gall, Switzerland, 7 Feb. 1837. He succeeded on the death of his father, Gustavus III., and, on assuming power, showed that he had inherited his father's hatred of the principles of the French revolution, which he carried to the extent of fanaticism. In 1803 he made a journey to Germany to promote a union of the German princes against Napoleon. He was at Karlsruhe when the Duke D'Enghien was seized, and sent his aide-de-camp to Paris to protest against that act of violence. After the Peace of Tilsit he exposed himself to a war with Russia while he was at war with France, by refusing to join the continental blockade and opening his ports to England; and in 1808 he quarreled with England, his only ally. His internal policy was as bad as his external. His subjects were oppressed with taxes to support his wars, and had in return the humiliation of finding Pomerania in the possession of France, and Finland in that of Russia. A conspiracy was formed against him; he was deposed, and the diet by a decree of 10 May 1809 declared his family forever incapable of succeeding to the crown of Sweden. His uncle, the duke of Sudermania, was proclaimed king, under the title of Charles XIII., and in the following year adopted as his successor, Bernadotte, prince of Pontecorvo. Gustavus died in poverty. He took the title of Colonel Gustafson, and has left, among other writings, 'Memoirs of Colonel Gustafson' (1823). See Kleinschmidt, 'Die Irrfahrten Gustavus IV. Adolf von Schweden' (1888).

Gutenberg, goo'tĕn-bĕrg, **Johannes or Henne**, German inventor of printing with movable types: b. Mainz about 1400; d. there 23 Feb. 1468. Little or nothing is known of his early life. In 1434 he was living in Strasburg, and in 1436 entered into a contract with one Andreas Dryzehn or Dritzehn and others, binding himself to teach them all his secret and wonderful arts, and to employ them for their common advantage. The death of Dryzehn, which happened about the end of 1438, broke off the undertaking of the company. About 1448 he returned to Mainz, and soon formed a copartnership with Johann Fust or Faust, a rich goldsmith who furnished money to establish a press, in which the Latin Bible was first printed. This, the Mazarin Bible, begun about 1450 and finished about 1455, is the first book known to have been printed with movable types. After some years this connection was dissolved. Fust had made large advances, which Gutenberg was now called upon to repay; and as he either could not or would not do it, the subject was carried before the tribunals. The result was that Fust retained the press, which he improved, and continued to use in company with Peter Schöffer of Gernsheim. By the patronage of a counsellor of Mainz, Conrad Hummer, Gutenberg was again enabled to establish a press the following year, from which there issued the fine 'Catholicon' of 1460, and also the 'Letters of Indulgence' of 1454 and 1455. Gutenberg's name does not appear in any production of his press, nor do any of his friends and patrons mention him in connection with the invention of printing. See Van der Linde, 'Gutenberg' (1878), and 'Geschichte der Erfindung der Buchdruckerkunst' (1886); Hessel, 'Gutenberg: Was He the Inventor of Printing?' (1882); 'Haarlem the Birthplace of

Printing, not Mentz' (1887); Gordon Duff, 'Early Printed Books' (1893).

Guthrie, Thomas, Scottish clergyman and philanthropist: b. Brechin, Forfarshire, 12 July 1803; d. Saint Leonard's, Sussex, 24 Feb. 1873. He was educated at the University of Edinburgh, and was licensed as a preacher in connection with the Church of Scotland in 1825. He accepted a call to Greyfriars, Edinburgh, in 1837, where he soon became very popular with all classes. In 1843 the Disruption took place, and Guthrie was active with Chalmers and Candlish in organizing the Free Church, becoming minister of Free St. John's, Edinburgh. The work with which his name is chiefly identified out of Scotland, was the establishment of ragged schools, of which he was the earliest advocate. He was widely known for his gifts as an orator, and on retiring from the ministry in 1864 was editor of 'The Sunday Magazine' till his death. Among his published works are: 'The Gospel in Ezekiel' (1855); 'A Plea for Ragged Schools' (1847); 'The City: its Sins and Sorrows' (1857); 'Autobiography' (1874-5). See Smeaton 'Thomas Guthrie' (1900).

Guthrie, Thomas Anstey ("F. Anstey"), English humorist: b. Kensington, London, 8 Aug. 1856. He was graduated from Cambridge in 1875, and called to the bar in 1880, but never practised and has devoted himself to authorship, his books having been extremely popular both at home and in the United States. He is the author of 'Vice Versa' (1882); 'The Giant's Robe' (1883); 'The Black Poodle' (1884); 'The Tinted Venus' (1885); 'A Fallen Idol' (1886); 'The Pariah' (1889); 'Tourmalin's Time Cheques' (1890); 'Voces Populi' (1890); 'Mr. Punch's Pocket Ibsen' (1893); 'Puppets at Large' (1897); 'Love Among the Lions' (1898); 'The Brass Bottle' (1900); 'A Bayard From Bengal' (1902); etc.

Guthrie, William Norman, American Episcopal clergyman and author: b. Dundee, Scotland, 4 March 1868. He was graduated from the University of the South in 1889 and was professor of modern languages there 1889-90, and at Kenyon College, Ohio, 1892-3. He entered the Episcopal ministry in 1893, and has since been rector of several Cincinnati churches. He has published: 'Love Conquereth' (1890); 'Modern Poet Prophets: Essays Critical and Interpretative' (1897); 'Songs of American Destiny' (1900).

Guthrie, Okla., the capital of the Territory of Oklahoma and the county-seat of Logan County, on the Cottonwood River and on the Atchison, Topeka & Santa Fe, the Chicago, Rock Island & Pacific, the Oklahoma Eastern, the M. K. & T., St. Louis & San Francisco, Fort Smith & Western, Denver, Enid & Gulf, and the St. Louis, El Reno & Southern Rys.

Industries, Etc.— Guthrie has a very large trade, and is especially noted as a wholesale distributing centre. It has planing, flour and cotton-seed oil mills, furniture and carriage factories, a foundry and machine shops, a broom works, a plow factory, creamery, railroad repair shops, novelty works, book bindery, etc.

Buildings, Educational Institutions, Etc.— Guthrie's chief buildings are the capital, Federal court and post-office building, the city hall, the Scottish Rite temple, Carnegie Library, and the Federal prison. The Carnegie Library (costing $25,000) is a noteworthy institution. The city possesses an excellent public school system, including a high school, Saint Joseph's Academy, and many private schools add to the city's educational facilities. A $50,000 county high school has just been built, and the Capitol University is located on a height overlooking the city on the west.

Government.— The city is governed by a mayor and a council of ten members elected biennially. The chief of police and all other city officers are chosen by the people. The city has electric lighting and owns and operates its own water-works, has several miles of paved streets, large gas plant and work has begun on a street railway.

History.— Guthrie dates its existence from the opening of the territory in 1889, and it was made the capital city one year later, in 1890. The city has had a rapid development and has had a rival in Oklahoma City, about 30 miles south. Pop. (Federal census of 1900) 10,006; (territorial census of 1904) 23,000.

Gut'ta Per'cha, a substance which has been known generally and used in Western countries only since about 1845, though travelers and residents in the East were acquainted with it long before, and had seen various articles made of it, but without knowing the nature of the material. It is the inspissated milky juice of several large trees belonging to the order *Sapotaceæ*, the principal being *Isonandra gutta*, and is obtained by felling the large and old trees, cutting off rings of bark at intervals along the stem, collecting the juice which issues, and concentrating by evaporation, if necessary. The result of this terribly wasteful process is, that the gutta percha tree has been exterminated from various districts in which it was formerly abundant. The tree is found in the Malayan peninsula, and in some of the neighboring islands, in great numbers and of very large size; but if these trees be also cut down, instead of the juice being tapped by incisions (a method which has now come into use), gutta percha will become one of the rarest of substances.

The crude substance is gray or reddish, and is mixed with fragments of bark, leaves, and other impurities, from which it is separated by washing with cold and then with warm water. This softens the gutta percha, and the impurities can be easily picked out. When pure it has a brown color; at the ordinary temperature it is hard and tough, and in not too thick pieces is flexible like leather. It is elastic only to a very slight extent, and cannot be beaten out. It has little or no adhesion for other bodies, but its own cohesiveness is remarkable, a thin strip of it bearing a very considerable weight. When warmed it gradually softens, and then can be drawn into fine fibres, rolled into sheets, or molded. For the latter purpose it is admirably adapted, as when warm and soft it takes the finest impressions, which it retains after it has become cold and hard. When heated to a sufficiently high temperature in the air it catches fire, and burns with a bright flame; heated in close vessels it gives off oily hydrocarbons and an acid liquor, so that gutta percha seems to consist mainly of carbon and hydrogen, with some oxygen, while nitrogen is absent, or present only in very minute quantities. Attempts have been made to resolve gutta percha into

proximate constituents, and accordingly three substances extracted from it have been described. These are named respectively gutta, which is the chief constituent, and when pure is white and opaque; alban, a white oxygenated crystalline substance; and fluavil, also oxygenated, and of a yellow color. These two are said to be formed from the first by oxidation, but there is a considerable diversity of opinion on the nature of these bodies. Ordinary gutta percha is insoluble in water, partially in alcohol and ether, readily and completely in chloroform, turpentine, benzol, bisulphide of carbon, and naphtha. It is also dissolved to a slight extent by oils. It is not attacked by solutions of alkalies, nor by hydrofluoric acid; but it is acted on by sulphuric, nitric, and hydrochloric acids — being darkened in color, oxidized, rendered brittle, or altogether disintegrated — and by chlorine, which transforms it into a white substance like ivory. It is also affected by the oxygen of the air, especially in light, becoming brittle, resinous, and acid; it combines with sulphur and, like caoutchouc, can be vulcanized. Gutta percha is employed for a great variety of purposes, especially for insulating electric wires, being invaluable for submarine telegraph cables because, as a natural insulator of electricity, it is not affected by water, is very pliant, and forms a uniform and close-fitting coating to the wires. It is much prized for making certain kinds of surgical instruments, and in sheets for surgical dressing, and is used for making water-pipes and tubes of various kinds, hose, machine-belting, soles for shoes, golf-balls, overshoes, buckets, picture-frames, and many other articles in general use.

Guy, Thomas, English philanthropist: founder of Guy's Hospital, London: b. about 1645; d. December 1724. His principal income arose from the disreputable purchase of seamen's prize tickets in Queen Anne's war, and from his dealings in South Sea stock in 1720. By these speculations, aided by most penurious habits, he amassed a fortune of nearly half a million pounds sterling, of which he spent upward of $1,000,000 in building and endowing his hospital in Southwark. He also erected almshouses at Tamworth, furnished three wards of St. Thomas' Hospital, and benefited Christ's Hospital and various other charities. He was member of Parliament for Tamworth 1694–1707.

Guy Mannering, a novel by Sir Walter Scott. It was the second of his novels, appearing anonymously in 1815, seven months after 'Waverley.' It is said to have been the result of six weeks' work, and by some critics is thought to show the marks of haste. Its time is the middle of the 18th century, its scene chiefly Scotland. There are fewer than two-score characters in 'Guy Mannering,' and the plot is not very complicated. Meg Merrilies, and Dominie Sampson, the uncouth, honest pedant, are the only great creations it contains.

Guy of Warwick, a metrical romance belonging to that Anglo-Danish cycle from which the Norman trouvères drew so much material. The earliest existing manuscripts of this romance are in French; though it is supposed to have been written by Walter of Exeter, a Cornish Franciscan. It consists of about 12,000 verses, iambic measure, arranged in rhymed couplets.

Guyon, Jeanne-Marie Bouvier de la Motte, zhän mä-rē boo-vē-ā dė lä mŏt gē-ôñ, Madame, French mystic: the introducer in France of the system of Quietism, b. Montargis 13 April 1648; d. Blois 9 June 1717. At the age of 16 she was married to Jacques Guyon, after whose death in 1676 the tendency to mystic enthusiasm which had characterized her younger years again acquired ascendency. She published numerous works, such as 'Le Cantique des Cantiques interprété selon le Sens Mystique' (1685); 'Poésies Spirituelles' (1685); 'Discours Chrétiens et Spirituels' (1716); etc. At last the archbishop of Paris thought it necessary to take steps against the spread of Madame Guyon's mystical doctrines, and through his influence she was shut up in the convent of the Visitation, but afterward released at the instigation of Madame Maintenon, who herself became for a time a convert to the new doctrines, and allowed Madame Guyon to preach in the seminary of St. Cyr, where she made a convert and disciple of Fénelon. A commission of ecclesiastics, chief among whom was Bossuet, now sat in judgment, and the doctrines of Madame Guyon were condemned (1695). This led to her being imprisoned for some years, latterly in the Bastille, whence she was liberated in 1702. The rest of her life was spent in retirement and in works of charity. See Upham, 'Life, Religious Opinions, and Experiences of Madame Guyon' (1870); Guerrier, 'Madame Guyon, sa vie, sa doctrine, son influence' (1881).

Guyot, gē-ō, **Arnold,** American geographer: b. near Neuchâtel, Switzerland, 28 Sept. 1807; d. Princeton, N. J., 8 Feb. 1884. He studied theology at Neuchâtel and Berlin; but later turned his attention to natural science, and in 1835 took the degree of doctor in the University of Berlin. He then went to Paris, where he resided five years, passing the summers in scientific excursions through France, Belgium, Holland, and Italy, examining the characteristic physical features of those countries. In a tour of Switzerland, in 1838, he ascertained and announced in a communication to the Geological Society of France several of the most important laws concerning glaciers. He first discovered the laminated structure of the ice, and showed that the motion of the glacier is due to the displacement of its molecules. These discoveries were fully confirmed and illustrated by the investigations of Agassiz, Forbes, and others. He next investigated the distribution of erratic boulders, in order to solve the question of the mode of their transportation. During seven summers he traced them on both sides of the central Alps, in Switzerland and Italy. Their vertical limits and the laws of their descent were determined by means of more than 3,000 barometrical observations; and the characteristic species of rock of each basin were tracked step by step to their source, often in the midst of the highest regions of ice and snow. A collection of more than 6,000 specimens of rocks was made as vouchers for the results. The full details of these investigations were announced to form the second volume of the 'Système glaciaire' by Agassiz, Guyot, and Desor, the first volume of which was printed in

Paris in 1848; but the political disturbances of that epoch and the removal of Guyot to the United States prevented its publication. The main results, however, are to be found in the 'Bulletin de la Société des Sciences Naturelles de Neuchâtel,' and in D'Archiac's 'Histoire de la Géologie'; and have since passed into various scientific manuals. In the College of Neuchâtel, which numbered Agassiz among its professors, Guyot occupied, from 1839 to 1848, the chair of history and physical geography. In the latter year a political revolution in Neuchâtel broke up the institution, and he was induced by Agassiz to remove to the United States. He resided for several years at Cambridge, Mass., occupying himself with the study of the physical geography of the American continent, and first became extensively known in this country by a course of lectures delivered in Boston in the winter of 1848–9 in the French language, on the relations between physical geography and history. These were translated and afterward collected into a volume entitled 'Earth and Man' (1849). The work had a large circulation in the United States, where it was extensively used as a text-book. For several years Guyot was employed by the Massachusetts board of education to deliver lectures in the normal schools of the State and before teachers' institutes, and in this way, addressing annually 1,200 or 1,500 teachers, he exercised an important influence in reforming the method of teaching geography. From 1855 until his death he was professor of geology and physical geography at Princeton. His meteorological observations, undertaken for the government, were the basis of the present United States weather bureau. Among his further works are 'Treatise on Physical Geography' (1873); 'A Memoir of Agassiz' (1883); and 'Creation, or the Bible Cosmogony in the Light of Modern Science' (1884).

Guyot, Yves, ēv, French publicist: b. Dinan, France, 6 Sept. 1848. He began his studies at Rennes, and early interested himself in social and economic problems of international importance. He took part in the revolution of 4 Sept. 1870, which, after the surrender of Sedan, established the third Republic. He is an ardent reformer, but not a socialist, a free-trader and member of the Cobden Club. In 1885 he was elected to the French Parliament, and in 1889 made minister of public works. He has for years been editor of the *Siècle,* a Liberal paper of a staid, old-fashioned style. He took a prominent part in the defense of Dreyfus, and waged a successful war for the abolition of the continental sugar bounties. Among his writings may be noted 'La Tyrannie Socialiste' (1893); 'Les Principes de '89 et le Socialisme' (1894); 'L'Economie de l'Effort' (1896); 'Le Bilan de l'Eglise' (1901); and 'La Question des Sucres' (1901).

Guzerat, gŭz-ĕ-rät'. See GUJARAT.

Guzman Blanco, Antonio. See BLANCO, ANTONIO GUZMAN.

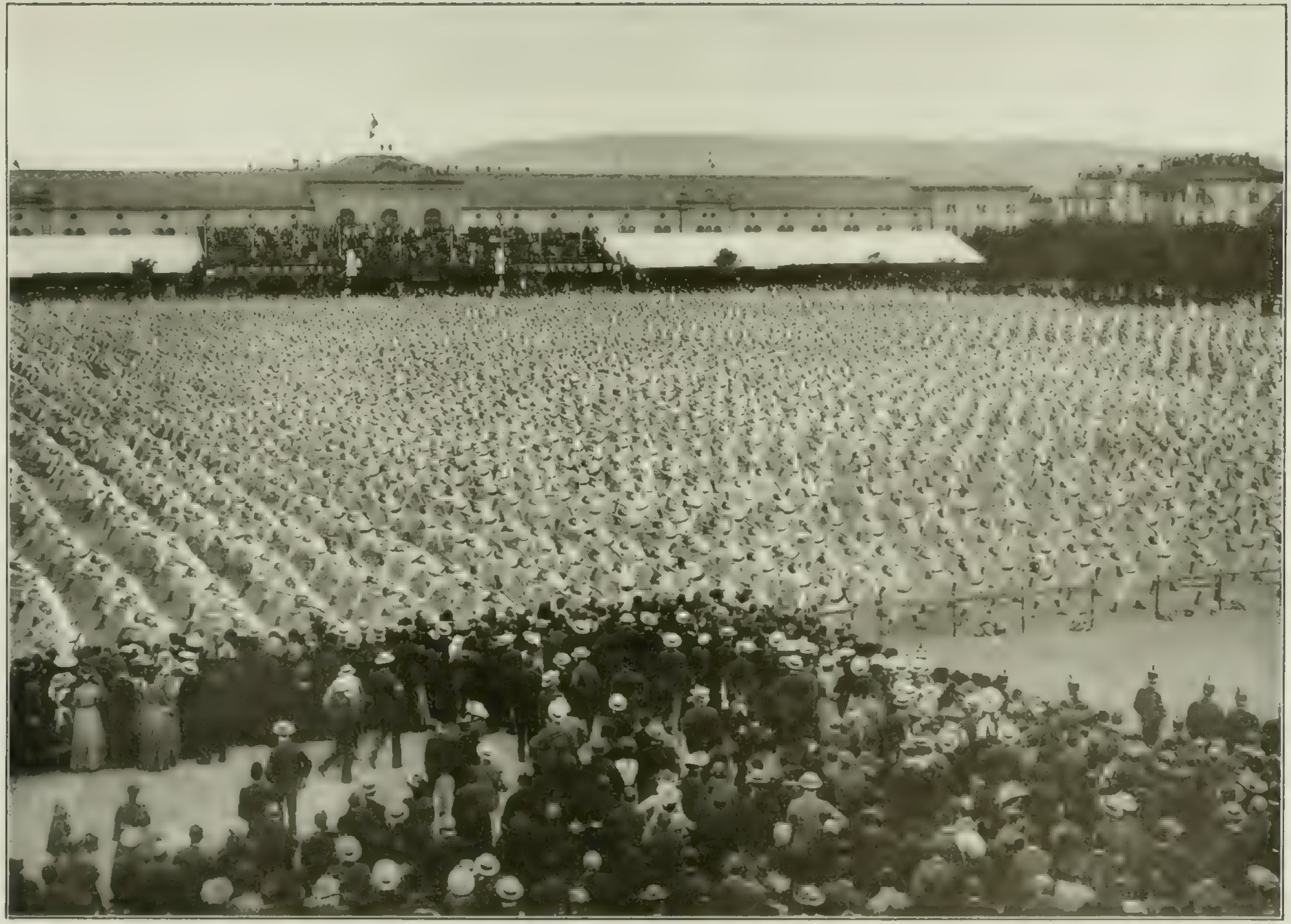
Gwin'nett, Button, American patriot, one of the signers of the Declaration of Independence: b. England about 1732; d. Georgia 27 May 1777. He emigrated from Bristol to America in 1770, purchased a tract of land on St. Catharine's island, Georgia, and devoted himself to agriculture. He became conspicuous in 1775 by his maintenance of the colonial rights, was elected a representative to Congress in Feb. 1776, and re-elected for the following year, and in 1777 became president of the provincial council, the highest station in Georgia. He planned a military expedition against East Florida, which he refused to entrust to his rival Gen. McIntosh, whose official rank entitled him to command it, and which resulted disastrously. This event, aggravated by other disturbances, led to a duel between him and McIntosh, in which he was mortally wounded. See Dwight, 'Lives of the Signers' (1895).

Gwynn, Eleanor, commonly **Nell Gwynn,** English actress: b. Hereford, England, 1650; d. London 1687. She was at first an orange girl, and also gained her bread by singing from tavern to tavern. She became the mistress of Hart and Lacy, the actors, before going in her 16th year upon the stage, where she distinguished herself in light comedy. About 1667 she became the mistress of Lord Buckhurst, who surrendered her to the king. She caused much embarrassment to the Duchess of Portsmouth, who deemed herself too refined for such a rival. It is said that in her elevation she showed her gratitude to Dryden, who had patronized her in her poverty; and, unlike the other mistresses, was faithful to her royal lover. From her are sprung the dukes of St. Albans.

Gymkhana, jĭm-kä'na, a term of Hindu origin, presumably derived from *gend-khana,* that is, ball-house, and associated by Anglo-Indian soldiers and civilians with "gym" or gymnasium, whence its introduction into the English language. It is applied to a building or grounds arranged for athletic recreation, and signifies also the open air meetings for athletic and other mixed sporting events, including horse racing, which are the annual features of almost every military cantonment throughout India.

Gymnastics, History of. The development of gymnastics began in an early period of Grecian and Roman history. Systematic exercise received the stamp of approbation from the most eminent educators of ancient times, and has the endorsement of all teachers to-day. Such exercise has had its periods of decline in popularity, due to the development of professionalism, stimulated by the conferring of extravagant honors and rewards which caused the ranks of the athletes to be filled by a professional class of low extraction, who made their art a trade. But through these periods of decline there have been those who have kept in mind the true value and aim of regularly and systematically conducted exercise; and these advocates have outlived and lived down these evils. So that we find that the scientifically conducted gymnastics have never entirely lost their hold upon educators and those interested in the betterment of mankind.

Modern gymnastics differ considerably from the exercises of the ancients, which at first consisted of athletic feats performed by each individual according to his own notion, and were encouraged among the youth as combining amusement with exercise. They were at length reduced to a system which, in Greece, formed a prominent feature in the state regulations for



SWISS GYMNASTS, AT BERN.

education. In fact the period for gymnastics was equal to the time spent on art and music combined. Public games were consecrated to the gods, and were conducted with the greatest ceremony. The earliest mention we can find of gymnastic sports is in Homer's 'Iliad,' Book II., and again in Book XXIII., when Achilles instituted games in honor of Patroclus, and distributed prizes to the victors for boxing and wrestling. Plato tells us that just before the time of Hippocrates gymnastics were made a part of medical study, because they were suited to counteract the effects of indolence and luxurious feeding, and that at length they became a state matter reduced to a system and superintended by state officers. The first public gymnasia were built by the Lacedæmonians. These were imitated at Athens, where, in one called the Academy, Plato instructed his pupils, and in another, the Lyceum, Aristotle taught. These buildings were superintended by a chief officer. The athletics were in charge of a director, and medical officers were in attendance to prescribe the kind and extent of exercise. Baths were attached to the gymnasia, and a hot bath, followed by a cold plunge, was recommended. Plato and Aristotle considered that no republic could be deemed perfect in which gymnasia, as part of the national establishment, were neglected.

The Spartans were the most rigid in exacting for their youth a gymnastic training; even the girls were expected to be good gymnasts. The exercises for pupils in the gymnasia consisted of a sort of tumbling, war-dances, running — for both sexes — leaping, climbing ropes; of jumping or springing from the knees, with weights attached to the body, maintaining the equilibrium while jumping on slippery skins filled with wine; and of wrestling for the throw. Riding, driving, swimming, rowing, and swinging supplemented the indoor work.

During the Middle Ages the knightly amusement of the tournament absorbed nearly every other sport except foot-racing and wrestling, so that gymnastics fell into disuse till Basedow (q.v.) in 1776, at his institution in Dessau, united bodily exercises with other instruction. This example was followed by Salzmann at his institute and, from this small commencement, the practice gradually extended. In the latter part of the 17th century gymnastics were extensively introduced into Prussian schools by Guts Muths, who wrote several works on the subject. In 1810 the system was still more widely spread by Jahn, who is regarded as the founder of the present Turnverein (q.v.). Prussia at that time was impatient under Napoleonic rule, and Jahn conceived the idea of bringing together the young men for the practice of gymnastic exercises, and, at the same time, indoctrinating them with patriotic sentiments which might be made available to expel the French from Germany. The Prussian government favored the plan, and, in 1811, a public gymnastic school, or Turnplatz, was opened at Berlin, and was quickly imitated all over the country. In 1813 the citizens were called to arms against the French, and Jahn himself commanded a battalion of Lutzow's volunteers. When, however, there was no longer any reason to dread the French, the government of Prussia, regarding the meeting of patriotic young men as a means of spreading liberal ideas, closed the gymnastic schools and Jahn was imprisoned. In other countries, however, the system introduced by Jahn was eminently successful, especially in England, Switzerland, Portugal, and Denmark. It was first introduced into female education under the name of calisthenics when systematic exercises were added to hoop-trundling, skipping-ropes, etc., and to riding, archery, and other healthy outdoor exercises practised among the women.

The masculine sports of cricket, football, quoits, boxing, wrestling, leaping, foot-racing, etc., have been for centuries enjoyed by the boys of England in the playgrounds attached to the schools. In 1848 the political condition of Europe enabled the Turnvereine to be reorganized and the German emigration to the United States has brought these institutions with it. The first society was formed in New York. The organization, as first established, was confined to the practice of bodily exercises; but soon assumed a higher scope. Libraries were collected, schools established, a newspaper ('Turnzeitung') founded; and various arrangements were made for the diffusion of useful knowledge, and for mental culture as well as physical training. Much credit must be given to Ling for his efforts to develop educational gymnastics. He has many followers, and his publication on 'Educational and Curative Gymnastics' has much merit. Ling has been severely criticised by English writers for his claims to originality. They go so far as to say that he simply used the works of authors of his time and of an earlier period, and took his *holus-bonus* from Dr. Francis Fuller in the 'Medicina Gymnastica.' The first edition was published in 1728, and it ran through eight others. It is also claimed that he borrowed in its entirety without acknowledgment, the work of one John Pough, 'A Physiological, Theoretic, and Practical Treatise on the Utility of the Science of Muscular Exercise for Restoring the Power of the Limbs,' with such materials and German gymnastics as had previously found their way through Denmark and Sweden. Through the exertions of such men as Salzmann, Jahn, and others, together with certain English authorities as, Fuller, Pough, Croft, Clias, Thomas and John Graham it was not difficult to establish a system. In fact Salzmann's gymnastics for youth needs only what Pough supplies to give all that Ling calls his system which is only adapted to beginners. The quality of the Ling exercises is stilted, and there is little scope for variety. The fact is, the system sticks too closely to automatic movements, which undoubtedly produce precise and studied monotony in drill.

Turning now to the Dio Lewis period, we see that it marks an epoch in the introduction of an American system of physical training formed in a small measure upon the Swedish and largely upon the German system. This system incorporated free-arm exercises, the use of dumbbells, clubs, rings, wands, together with what was then called the Pangymnastikon, but which was nothing more or less than a pair of flying rings equipped with a pair of detachable stirrups from which swinging, jumping, and stretching exercises were performed. Dio Lewis' work took up the matter of the school-desk, criticised the faulty position of the ordi-

nary desk, and the poor school-room ventilation. In 1861 the Normal Institute for Physical Education was incorporated and located in Boston. Its directors included many of the most distinguished educators of New England, and its departments of anatomy, physiology, and hygiene were in charge of able teachers. Dr. Dio Lewis gave the work in gymnastics. The aim of the institute was and is to furnish competent advocates and teachers of physical training.

Next follows the work of Dr. Sargent, with his American system of gymnastics. Dr. Sargent was born in Maine. He was fond of all kinds of outdoor sports and physical exercise, and joined a gymnasium club while attending high school; but as he had to work out of school hours to support his family, he could only attend to his exercising at odd moments as time permitted. On one occasion he broke a piece of apparatus and was expelled from the club. Piqued and aroused, he improvised an apparatus of his own in a barn. Shortly afterward the club gave a display and, after the members had finished, Sargent and a friend came forward and easily surpassed the athletic feats performed by the others. This event is said to have been the direct cause that led Dudley Sargent to become an ardent physical educator. He was graduated from high school in 1867, was invited to become teacher of gymnastics in Bowdoin College in 1869, and entered the college as a freshman in the regular course and conducted the physical work. In an endeavor to arouse the faculty and the public to the necessity for physical training, he was successful to the extent that, in 1871, gymnastics became a part of the regular curriculum, and Mr. Sargent, though a student only 22 years of age, was placed at the head of the department, and filled the position with credit. About this time he brought out his system of chest-weights. In 1872 he accepted a position as director of the Yale College gymnasium, and for three years had charge of both Yale and Bowdoin, spending part time in each place. It was while at Yale that he fully developed the "individual apparatus" for which he is so well known. At the solicitation of friends he went to New York and started a gymnasium on Fifth Avenue, which at once sprang into popularity. In 1879 he accepted the appointment of director of the Hemenway Gymnasium and assistant professor of physical training at Harvard University. This promotion of the department of physical training to a rank equal to the scholastic departments of the university was a great stride forward, and stamped the new system with the mark of public approval. To Dr. Sargent is the credit due for the invention of the chest-weight, the intercostal machine, quarter-circles, leg and finger machine, and other appliances to the number of 30 or more. He also elaborated a system of anthropometric measurements which enable an examiner to ascertain at once the physical condition of a student, and which guided a director in prescribing proper exercises for the development of deficient parts. Dr. Sargent believes in special work for individuals, and will not allow a man or woman to go into the gymnasium and take the drills and work with the apparatus indiscriminately. Health, harmony, and symmetry are the results aimed at.

About the same time, physical training was taken up by and introduced into the Young Men's Christian Association, whose local gymnasia have done much to give the work a moral tone. We owe a great deal to such men as R. J. Roberts of Boston, whose name has been associated with the advancement of physical education since 1875, and whose dumb-bell drill and book of exercises has long been a standard in the association's work. The organization of the physical work under the auspices of the Y. M. C. A.'s has been practically responsible for the systematization of the American system of gymnastics, and for the establishment of a universal nomenclature of gymnastics. Among those who have done most for physical training along educational lines, I would mention Dr. Hartwell of Boston, Dr. Gulick of New York, and Dr. Seaver of Yale.

To-day, practically, all private schools have a well-equipped gymnasium under the direction of a man who has had special training in the application of exercise, the theory and practice of gymnastics, and who is, in many cases, a medical graduate. Systematic progressive courses of work are conducted, which aim to develop and strengthen, to give co-ordination and grace, and to make the individual self-reliant and resourceful. The equipment required to obtain this result is necessarily extensive, consisting of a gymnasium, say 50 x 100 feet, with clear floor space, high-vaulted roof, a fine system of ventilation, and with every variety of apparatus which the ingenuity of the specialists, and the energy and resourcefulness of the manufacturers, can provide. The equipment consists of light apparatus — dumb-bells, Indian clubs, bar-bells, wands; heavy apparatus — German horse, parallel bars (suspended and floor), horizontal bars (high and low), buck, flying rings, traveling rings, horizontal and vertical ladder, climbing ropes, rope ladders, spring-boards beat-boards, floor-mats, wrestling and tumbling mats, Swedish stahl bars, booms, serpentine ladder, and balance-beams; as well as special apparatus — chest-weights, intercostals, quarter-circle, chest-expander, traveling parallels, wrist-machine, long inclined plane, sculling-machine, paddling-machine, leg-machine, neck-machine, bicycle-trainer, and so on through an almost endless variety. No plant is complete without its swimming-tank, varying in size from 15 x 45 up; its shower-baths, needle-baths, tub-baths; and some have steam-rooms and massage-tables. An indoor running track is an almost indispensable adjunct to all well-equipped gymnasia; and there should also be the equipment for indoor athletics during the winter months. Provision for indoor games is also essential — basket-ball, baseball, and ring-hockey. Each school has adjacent athletic grounds with tennis-courts, quarter-mile track, football and baseball fields, and golf course. See Physical Culture.

The college physical departments surpass those of the preparatory schools only in size and extent of equipment. Harvard University probably excels all others in point of variety of equipment for special work. The summer work in the public parks and school playgrounds must also be noted. These out-of-door gymnasia are equipped with extensive apparatus for all outdoor work. Preparatory school work in gym-

nastics is, by general consent, made to consist of a system of corrective, body-building exercises, made up of free-arm work and light calisthenics in the lower grades, followed by heavier calisthenics, dumb-bells, clubs and wands, light apparatus, intermediate and advanced apparatus, boxing, wrestling, and fencing, interspersed with periods for recreative games, competitions, and contests of skill and strength.

Bibliography.— Alexander, 'Modern Gymnastic Exercises' (1890); Stebbins, 'Delsarte System of Expression' (1892); Posse, 'Special Kinesology of Educational Gymnastics' (1894); Ravenstein, 'Volksturnbuch' (1894); Broesike, 'Der Menschliche Körper, mit besonderer Berücksichtigung des Turnens' (1894); Nissen, 'Rational Home Gymnastics for the Well and the Sick' (1898).

J. Martin Voorhees,
Director of Gymnasium, Pratt Institute, Brooklyn, N. Y.

Gymnophiona, jĭm-nō-fī'ō-na. See Cæcilians.

Gymnosperm, jĭm'nō-spėrm, a plant with a naked seed. Among the gymnosperms are the cycads, gingkos, conifers, and *Genetaceæ*. The last group is represented by a single extraordinary tree or plant of West Africa (*Welwitschia mirabilis*), the stem of which, looking like a huge wood-fungus, may, when mature, be a little over a foot high but several feet across. It bears but two leaves, the cotyledons, which sometimes grow to be 5 or 6 feet long and 2 or 3 feet wide, ultimately splitting into strips. The plant is said to live over 100 years.

Gymnotus, jĭm-nō'tŭs. See Electric Fishes.

Gynæcology, in medicine and surgery, the science which treats of the physical organization of women and of the diseases peculiar to them.

Gyp, pseudonym of Sibylle Gabrielle Marie Antoinette de Riquetti de Mirabeau, Comtesse de Martel de Janville. See Martel de Janville.

Gypsophila, jĭp-sŏf'ĭ-la (Baby's Breath). A genus of European and Asiatic annual and perennial herbs of the natural order *Caryophyllaceæ*. They are highly valued and widely planted for their small flowers which, being upon branchy stems, give a pleasing effect to bouquets and a mist-like grace to flower-borders. They are of simplest culture upon somewhat dry soils, especially among rocks and in sunny situations. The perennial species are hardy. Six or more species and a few varieties are cultivated in American gardens and greenhouses.

Gyp'sum, a native hydrated sulphate of calcium, having the formula $CaSO_4 + 2H_2O$; the water of crystallization being the only thing that differentiates it, chemically, from the orthorhombic mineral anhydrite. Gypsum is usually colorless or white. It crystallizes in the monoclinic system, contact twins and penetration twins being very common; and it also occurs in massive forms. The pure crystals have a hardness of from 1.5 to 2.0, and a specific gravity of about 2.32. Gypsum is an exceedingly abundant substance, and is met with in many parts of the earth, and in a variety of forms. When found in the form of clear, transparent crystals, it is known as selenite; when the mineral is finely fibrous, and the fibres are parallel to one another so as to form a mass with a pearly opalescence, the mineral is called satin spar; when it occurs in uniform, fine-grained, translucent masses, it is known as alabaster; and when it occurs in large beds of massive rock, often mixed with clay, calcium carbonate, and other impurities, it constitutes the earthy gypsum, or rock gypsum, of commerce. Gypsum is soluble in from 400 to 500 parts of water at ordinary temperatures, but it dissolves more freely in hydrochloric acid. When heated, it loses part of its water of crystallization, though it retains the power of recombining with water to form a hard, non-crystalline mass, if the temperature to which it is exposed does not exceed 500° F. It is this property of recombining with water, which gives to dehydrated gypsum much of its industrial value. (See Plaster of Paris.) When heated with charcoal, gypsum is converted into calcium sulphide, which dissolves readily in dilute acids, with evolution of sulphuretted hydrogen gas. In this way the sparingly soluble sulphate of calcium may be converted into the soluble chloride or nitrate of calcium. Gypsum, when pulverized, is used as a fertilizer, its efficiency in this respect being apparently due in large measure to the fact that it facilitates the decomposition of rocks containing alkaline silicates.

The production of gypsum in the United States, in 1901, was 1,246,649 short tons, valued at $1,577,493. Texas, Michigan, New York, and Iowa were the principal producing States. The United States ranks second in the world's production of gypsum, France being first, and Canada third.

Gypsy. See Gipsies.

Gyra'tion, Radius of. The energy required to set a body in rotation in any given manner depends on the arrangement of the mass of matter to be rotated. Thus, a mass made into a ring like a wheel with very light spokes requires the expenditure of more energy in order to set it to rotate once per second on its axis than would be required if the same amount of matter were made into a uniform circular plate of the same radius. The energy required to set any given body in rotation about any given axis depends, in fact, on the "moment of inertia" of the given body about that axis; and the mass of the body being given, the moment of inertia depends on the way in which the mass is disposed about the axis of rotation. The radius of gyration about a given axis is the distance from that axis at which the whole of the matter of the given body might be concentrated without altering the moment of inertia. The moment of inertia and radius of gyration for any given body about any given axis may be calculated mathematically. The two magnitudes are evidently of great importance in the theory of rotating bodies.

Gyrfalcon, jẽr'fä"kĕn. See JERFALCON.

Gyroscope, jī'rō-scōp, an instrument invented by Foucault to show the rotation of the earth on its axis. It consists essentially of a metallic disk capable of being set in very rapid rotation. The disk is supported in a ring, the axis of rotation being a diameter of the ring, and is pivoted so as to rotate with the smallest possible amount of friction. A disk in rapid rotation tends to keep the axis of rotation always pointing in the same direction; and if the ring described above be held in the hands, it will be found that though it may be carried about from place to place in any way, so long as no attempt is made to change the direction of the axis of rotation, any motion whatever which tends to alter the direction of that line meets with extraordinary resistance.

H

H the eighth letter of the English and other alphabets derived from the alphabet of the Latins. It was borrowed by the Latins from the alphabet of the Greeks, and in early Greek represented an aspirate consonant sound, but in the Greek of classical times it stands for the prolonged vowel sound of *e*, as omega (ω) stands for the prolonged sound of omicron (ο). The H is evidently a character borrowed from the Phœnician alphabet, where its form was 𐤇 and its sound guttural aspirate, like that of the corresponding Hebrew letter *cheth* or like *ch* in German and in Scotch. In Greek, after H was adopted as a vowel sign, the aspirate was represented by ʻ or ʽ either prefixed to a letter (ʽο) or written above it (ὁ): it was previous to this change that H was introduced into the Latin alphabet. It is probable that in early Latin this letter, occurring between two vowels, as in *nihil, mihi, traho, veho,* represented a guttural sound, as the *h* in *nihil* and *mihi* does still in the Italian pronunciation of Latin. But evidence exists that in the classical usage of ancient Latin speech initial *h* was of little account and was "silent" as in modern Italian and French: this is certain as regards the pronunciation of the vulgar; and that even the educated often "dropped the h's" we know from the fact that in ancient monuments we find Hannibal and Annibal, Hadria and Adria, herus and erus, haruspex and aruspex.

In Anglo-Saxon and earliest English speech *h* represents a guttural aspirate like German and Scotch *ch* in *ach, loch;* for example, in *niht* (night), *thoht* (thought) the *h* stood for the same sound as *ch* in the German words *nacht, gedacht.* In earliest English speech *h* was prefixed to *l, n,* and *r,* to represent a gutteral aspirate which is now entirely lost; examples, *hlaf* (loaf), *hnecca* (neck), *hring* (ring): the initial guttural in such words has been dropped, as in the names of the early Frankish kings Hlodowig became Ludovicus and Louis, and Hlothar became Lothair. The original guttural *h* in old High German *hros* is completely eliminated in the modern German *ross,* but is represented by the aspirate *h* in Old English *hors* (horse). The *h* after *w* in many words as wharf, what, when, etc., represents an initial aspirate in Old English hwarf, hwaet, hwaenne, etc.

H is added to various consonants to form digraphs for representation of various sounds, for example, *ch* as in chin, *sh* as in shy, *gh* as in gherkin, *th* as in thin, then; or even to represent sounds for which there is already a proper consonant in the alphabet, for example *ph* and *gh* for the sound of *f* (philter, rough), *ch* for the sound of *k* (chyle); in very many cases the digraph *gh* is employed simply as a memorial of an ancient etymology, as in plough, and not seldom for no discernible purpose at all, as in ghost; the form *rh* usually occurs in words of Greek origin, and recalls the Greek etymology (rhapsody), but again it is employed to suggest false Greek etymology (rhyme).

H. H. See Jackson, Helen Maria Fiske Hunt.

Haarlem, här'lĕm, Holland, the capital of the province of North Holland, 11 miles by rail west of Amsterdam, and five miles from the North Sea. The city is intersected by canals bordered by tree-lined avenues, and communicates with the Zuyder Zee by the Spaarne and the Ij. Its chief municipal building is the town hall, a 17th century palace of the counts of Holland, containing a library, art, and historical collections. In Haarlem wood a favorite pleasure resort is the Pavilion housing the Society for the Promotion of Industry, and containing the colonial and industrial museums. Chief among numerous educational institutions is the Teyler Museum, for the study of theology, natural science, and the fine arts. The finest ecclesiastical structure is St. Bavo's or the Groote Kerk, a 15th century late Gothic basilica, one of the largest churches in Holland, noted for its tower 260 feet high, and its large organ. Haarlem was important commercially as early as the 12th century, and although its manufacturing industries have declined, has cotton-mills, linen bleacheries, type foundries, breweries, etc. The town suffered during the revolt of the peasantry in 1492 and was deprived of its privileges by Albert of Saxony. During the war of independence it sustained a siege of seven months (1572–73) by the Spaniards, and capitulated only after a display of the noblest heroism and courage. It was retaken by the Prince of Orange in 1677. Pop. (1899) 64,069.

Haas, häs, **Johannes Hubertus Leonardus de,** Dutch painter: b. Hedel, North Brabant, 23 March 1832. A pupil of Jan van Os at Haarlem, he established his studio at Brussels in 1857, and attained an excellent reputation by his finely-colored animal studies and animal groups with background of Dutch landscape. In 1869 he received a gold medal at Munich for his 'Trio of Donkeys.' Others of his works are: 'The Three Comrades'; 'In the Dunes'; 'On the Bank of the Yssel'; 'Cattle at Pasture.'

Habakkuk, ha-băk'ŭk or hăb'a-kuk, the eighth of the twelve minor prophets. He was

of the tribe of Levi, and flourished about 600 B.C. His prophecy commences with a lamentation for the corruption and social disorganization which the prophet sees around him. He cries to God for help, and is answered by threatenings of swift vengeance. The prophet is commanded to write the vision of God's retributive justice as revealed to his prophetic eye. The doom of the Chaldæans is first told in general terms and the announcement is followed by a series of denunciations pronounced upon them by the nations whom they had oppressed. The whole concludes with a magnificent psalm (chap. iii.), 'Habakkuk's Pindaric Ode,' as it is called by Ewald, a composition unrivaled for boldness, sublimity, and majesty of diction.

Hab'berton, John, American author: b. Brooklyn, N. Y., 24 Feb. 1842. At first a printer he subsequently served in the Federal army, and later undertook editorial work in New York. His best-known book, 'Helen's Babies' (1876), attained great popularity both in America and in Europe. He has published also 'The Barton Experiment' (1877); 'Other People's Children' (1877); 'The Worst Boy in Town' (1880); 'Who was Paul Grayson?' (1881); a humorous 'Life of Washington' (1883); 'One Tramp' (1884); 'Brueton's Bayou' (1886); 'The Chautauquans' (1891); 'A Lonely Lover' (1893); 'The Tiger and the Insect' (1902); 'The Bowsham Puzzle'; 'Country Luck'; 'Little Guzzy'; 'Caleb Wright'; etc.

Habeas Corpus, hā'bē-as kôr'pŭs, an ancient English writ addressed to him who has another in custody, and commanding him to produce the body of the person named at a certain place and time. One of the purposes for which it was used was to recover freedom when wrongfully taken away. Personal liberty was asserted by the common law from its earliest ages, and it was always assailed by kings who would be absolute, and with an earnestness proportionate to their tyranny. Hence it became imperatively necessary, if subjects were to retain the control and disposition of their own persons, that they should demand a recognition of this principle from their sovereign, and in England the principle was declared in the most solemn manner in Magna Charta. It is there said that "no man shall be taken or imprisoned but by the lawful judgment of his peers, or by the law of the land." It became necessary, however, in the course of time to put down the abuses by which the government's lust of power, and the servile subtlety of crown lawyers, had impaired so fundamental a privilege; and this was effected by the Habeas Corpus Act passed in 31 Charles II. (1679). Of the political and social effects of this measure Blackstone writes: "If once it were left in the power of any, the highest magistrate, to imprison arbitrarily whomever he or his officers thought proper, there would soon be an end of all other rights and immunities."

The provisions of the act may be stated generally thus: (1) That on complaint or request in writing, by, or on behalf of, any person committed and charged with any crime (unless committed for treason or felony expressed in the warrant; or as, or on suspicion of being accessory before the fact to any felony, or upon suspicion thereof, plainly expressed in the warrant; or unless committed or charged in execution by legal process), the lord-chancellor, or any of the judges in vacation, upon viewing a copy of the warrant or affidavit that a copy is denied, shall (unless the party has neglected for two terms to apply to any court for his enlargement) award a habeas corpus for such prisoner, returnable immediately before himself, or any of the judges; and upon the return made shall discharge the party, if bailable, upon security being given to appear and answer to the accusation. (2) The writ shall be returned, and the prisoner brought up within a limited time, according to the distance, not exceeding 20 days. (3) Officers and keepers neglecting to make due returns, or not delivering to the prisoner, or his agent, within six hours after demand, a copy of the warrant of commitment, or shifting the custody of a prisoner from one to another, without sufficient reason or authority (specified in the act), shall for the first offence forfeit £100; for the second £200, to the party grieved, and be disabled to hold their office. (4) No person once delivered by habeas corpus shall be recommitted for the same offence, on penalty of £500. (5) Every person committed for treason or felony may insist on being tried at the next assizes, or admitted to bail, unless the crown witnesses cannot be ready in that time; and if not tried at the second assizes or sessions, he shall be discharged from the imprisonment. (6) The prisoner may apply either to the Court of Chancery, or to the Courts of Queen's Bench, Common Pleas, or Exchequer, and any judge denying such writ is liable to a fine of £500. As the Habeas Corpus Act extended only to cases where persons are imprisoned on criminal, or supposed criminal charges, the other cases being left to the operation of the common law, which was found defective, the statute 56 George III. was passed, which extended the writ to other cases. Under this last act any person confined, or restrained of his liberty (otherwise than for criminal matters, and except persons imprisoned under a judgment or decree for debt), may apply to any judge of the common law courts for a habeas corpus, on showing by affidavit that there is a reasonable and probable ground for complaint.

In times of great political excitement, and suspected treasonable conspiracies, the operation of the Habeas Corpus Act has been suspended, as in Ireland in 1866, by 29 Vict. But such suspension does not enable any one to imprison without cause or valid pretext for so doing. It only prevents persons who are committed from being bailed, tried, or discharged during the suspension, leaving to the committing magistrate all the responsibility attending on illegal imprisonment. It is not uncommon therefore to pass an act of indemnity subsequently, for the protection of those who either could not defend themselves in an action of false imprisonment, without making improper disclosures of the information on which they acted, or who have done acts not strictly defensible at law, yet apparently justified by the necessity of the moment. The English statute has been copied in the United States without essential change.

In the Constitution of the United States it is provided that "the privileges of the writ

of habeas corpus shall not be suspended unless when, in cases of rebellion or invasion, the public safety may require it." The scope of this provision came under discussion during the Civil War when the President of the United States authorized Lieut.-Gen. Scott, where in his judgment it seemed necessary, to suspend the writ. When on one occasion the general refused to obey the writ, Chief Justice Taney, who had issued it, uttered an opinion in which he declared that it was only in the power of Congress, and not of the President, to proclaim such suspension, a view which legal authorities seem inclined to agree with.

It has been decided by the Supreme Court, in view of possible conflicts of jurisdiction between State and Federal courts, that no State judge has a right to issue a writ of habeas corpus for the release of a person held under the authority of the Federal government. On the other hand the United States courts are more restricted in the power to issue such writs than the State courts. A Federal court may issue a writ of habeas corpus in cases coming within Federal jurisdiction. The circuit court may decide whether the person ought to be discharged, but cannot do this even in cases where the writ has been suspended. There are also several provisions made by which an imprisoned person, whose testimony in a court of law is required, may be released by a writ of habeas corpus in order to appear before the judge. The Supreme Court has not the power to issue this writ, excepting in response to an appeal. Consult: Blackstone, 'Commentaries'; Hurd, 'Habeas Corpus.'

Haberstich, Samuel. See BITTER, ARTHUR.

Hack'berry, an American tree of the elm family and genus *Celtis*, growing in dry woods throughout the eastern United States and Canada. It is small or middle-sized, with the aspect of an elm. The fruit (a globular drupe) is sweet and edible, as large as the bird-cherry, and ripening in autumn. Two species exist.— *C. occidentalis*, the northern hackberry, sugar-berry or nettle-tree; and a southern one (*C. mississippiensis*). The soft, coarse-grained yellow wood is of little value. It is affected by the same insects as injure the elm (q.v.).

Häckel, Ernst H. See HAECKEL.

Hack'ensack, N. J., city, county-seat of Bergen County, on the Hackensack River, and on the New York, S. & W., and Erie R.R.'s, 16 miles from New York. It is a residential city, but has brick, silk, and other manufacturing interests. It has a public library, high school, gas and electric light, waterworks, electric street railways connecting with surrounding towns and cities and with New York, and an assessed property valuation of over $5,000,000. Hackensack was settled by the Dutch in the latter part of the 17th century, and during the Revolution was occupied in turn by the British and American armies. Pop. (1900) 9,443.

Hacker, Arthur, English artist: b. London 25 Sept. 1858. He studied at St. John's College, London, was a pupil in art of the Royal Academy and of Léon Bonnet at Paris (1880–1), set up his studio in London, and painted, besides several portraits: 'Pelagia and Philammon'; 'By the Waters of Babylon'; 'Væ Victis'; 'Syrinx'; 'Sir Percival'; and other works.

Hack'ett, Horatio Balch, American Baptist clergyman and educator: b. Salisbury, Mass., 27 Dec. 1808; d. Rochester, N. Y., 2 Nov. 1875. He was professor of biblical literature at Newton (Mass.) Theological Seminary 1839–70, and of Greek at Rochester Theological Seminary, from the latter date. He was one of the committee of New Testament revision, and with Ezra Abbot (q.v.) edited the American edition of Smith's 'Bible Dictionary' (1868–70). His chief work was a 'Commentary on Acts' (1851); and he also wrote 'Memorials of Christian Men in the War' (1864); 'Tour in the Holy Land' (1866); etc.

Hackett, James Henry, American actor: b. New York 15 March 1800; d. Jamaica, L. I., 28 Dec. 1871. He went on the stage in 1826 and was particularly successful in impersonating Yankees and Westerners, but was best known by his Falstaff, which he played first about 1832. He was widely popular in the United States as well as in England. He published 'Notes and Comments on Shakespeare' (1863).

Hackett, James Keteltas, American actor: b. Wolfe Island, Ontario, Can., 6 Sept. 1869. He is the son of J. H. Hackett (q.v.). He was graduated from the College of the City of New York in 1891, made his début in 1892, became leading man of the Lyceum, New York, in 1896, and appeared in 'The Prisoner of Zenda,' 'Rupert of Hentzau,' 'The Pride of Jennico,' 'Don Cæsar's Return,' and 'The Crisis.'

Hackettstown, N. J., town in Warren County; on the Musconetcong River and on the Delaware, L. & W. railroad and the Morris Canal; about 59 miles from New York city, and 50 miles west of Newark. It is about 800 feet above the sea and within half a mile of the highest point in the State. Its chief manufactures are silk goods, carriages and wagons, and agricultural implements. The waterworks are owned and operated by the town, and the supply comes from springs on Schooley's Mountain, distant from the town about two and one half miles. It is the seat of the Centenary Collegiate Institute, under the auspices of the Methodist Episcopal Conference of Newark. Pop. (1900) 2,427.

Hackländer, Friedrich Wilhelm von, frēd'rĭн vil'hĕlm fōn häk'lĕn-dĕr, German novelist and writer of comedies: b. Burtscheid, near Aix-la-Chapelle, Prussia, 1 Nov. 1816; d. Leoni, near Munich, 6 July 1877. After serving for a time in the Prussian artillery he began a literary career with 'Pictures of Soldier Life' (1841), followed by 'Soldier Life in Peace' (1844). Other works of this period were 'Daguerreotypes' (1842); and 'Pilgrimage to Mecca.' In 1849 he went to Italy, where he was present with Radetzky's army during the campaign in Piedmont, and afterward published 'Soldier Life in War' (1849–50). Among the best of his longer novels are 'Trade and Traffic'; 'Eugene Stillfried' (1852); and 'Anonymous Histories' (1851). His best comedies are the 'Secret Agent' (1850), translated into several European languages, and 'Magnetic Cures' (1851). With Zoller, in 1885, he started the illustrated weekly 'Over Land and Sea.'

Hackley, Charles Henry, American capitalist: b. Michigan City, Ind., 3 Jan. 1837; d. Muskegon, Mich., 10 Feb. 1905. In 1856 he

went to Muskegon, Mich., and worked in a lumber-mill as laborer and foreman; then attended a commercial school and was given a position as bookkeeper and later came to be partner with a mill firm. In 1880 he founded the firm of which he is the head, which is one of the most important in the State, and he has also been interested in many other industries. He has been a member of the board of education, and was elected regent of the University of Michigan, but declined the office. He has made large gifts to the city of Muskegon. In 1888 he gave a public library, which he endowed in 1891; in 1889 he had a park made in a central part of the city in which he erected a soldiers' and sailors' monument and other statues; in 1891 he built and endowed a manual training school; in 1901, he provided for the erection of a hospital with a training school for nurses, and erected a statue of McKinley, the first statue of the late President to be unveiled. The total value of his gifts is $1,389,525.

Hackmatack, hăk'ma-tăk, the American larch. See LARCH.

Hackney, England, a metropolitan borough in the northeast of London, three miles north-northeast of St. Paul's. It has a fine modern town hall. Hackney was formerly noted for its boarding-schools for young ladies. It is supposed that hackney-coaches were first established between this place and London, and derived their name from it. It has manufactories of chemicals, india rubber, etc.; and had formerly extensive silk-mills. Pop. (1901) 270,535.

Hackney Carriage or **Coach**, a four-wheeled enclosed vehicle drawn by two horses and seating four persons exclusive of the driver. They are usually let out for hire. The carriage derives its name from Hackney (q.v.).

Haddam, Conn., a town and one of the county-seats of Middlesex County, 26 miles southeast of Hartford, on the New York, New Haven & Hartford R.R., and on the west bank of the Connecticut River, 29 miles above its mouth. Among its educational institutions is Brainerd Academy. It has important granite quarries, lumber and saw-mills, and a paper mill. Pop. (1900) 2,015.

Haddock, a fish (*Melanogrammus æglefinus*) of the same family (*Gadidæ*) as the cod, and much resembling it in general appearance. From the cod it may be easily distinguished by the black lateral line and suprapectoral blotches, and the swollen bones of the shoulder girdle. The haddock scarcely exceeds a weight of 15 pounds, and is usually about 3 or 4 pounds. It is restricted in its range to the North Atlantic. The food is extremely varied, consisting of every kind of bottom-living invertebrate. Spawning occurs in late winter and early spring, according to locality, and the eggs are essentially like those of the cod. Haddock associate with cod on the Banks, but the principal American fisheries are in Massachusetts Bay, on the Nantucket shoals and other points off southeastern New England, where immense numbers are taken on trawl and hand lines, especially during the summer. Philadelphia and Boston furnish the best markets for fresh haddock, but the demand from the interior is constantly growing. Though considerable quantities are salted at Provincetown, the haddock when so prepared is much inferior to the cod. The Scotch method of drying and smoking produces the much superior «Finnan Haddies,» and is largely practised at Portland and Boston.

Had'don Hall, an old English baronial mansion, the seat successively of Avenells, Vernons, and the Rutland family, stands on a slope overlooking the Wye in Derbyshire, 23 miles north-northwest of Derby. The styles of architecture range from Norman to the 16th century. Reference is made to it in Scott's 'Peveril of the Peak.' Although it is not inhabited it is in fine condition and remarkable as one of the most interesting extant examples of the country house of a great land owner in the late Middle Ages.

Haddonfield, N. J., a borough of Camden County, five miles southeast of Camden, a junction of two branches of the Camden and Atlantic railroad. Its industries are mainly agricultural; and it has also manufactures of stoves, tinware, watchcases, etc. Pop. (1900) 2,776.

Ha'den, SIR **Francis Seymour**, English etcher and surgeon: b. London 16 Sept. 1818. He studied at the Sorbonne and in the Paris and Grenoble medical schools, and in 1857 became a Fellow of the Royal College of Surgeons. The 'Etched Work of F. S. Haden' contains 185 plates by him and still others have been published in 'Études à l'Eau Forte' (1865–6). His work as an etcher is noted for both vigor and breadth. He is president of the Society of Painter Etchers, was knighted in 1894, and has written 'Rembrandt True and False'; 'Etched Work of Rembrandt' (1879–80); 'Lectures'; 'About Etching' (1881).

Hades, hā'dēz, the Greek name of a god, in large measure corresponding to the Roman Pluto, who reigned over the infernal regions. Both Greeks and Romans supposed the infernal regions to be in the centre of the earth. To enter these, the river Styx had to be crossed by the dead in the wherry of Charon. If, by any chance, the body lay unburied, the shade was detained 100 years on the banks of the Styx before crossing.

The Greek word Hades is rendered in the authorized version by the ambiguous term hell (q.v.). Expressions, most of them obviously figurative, used of Hades, represent it as subterranean; as having gates with keys in the hand of Christ, and as having, in a portion of it, souls in torment.

Had'is, or in Arabic plural, AHADIS, narrations or traditions, which relate to the Prophet Mohammed, and are not found in the Koran. There are numerous collections of these floating traditions, anecdotes and legends. A search for such data was first undertaken by Abdul Malik ibn Juraisch (d. 772 A.D.). Others consider that the collection of Imam Malik (d. 801) is the earliest extant. The following six Hadis collections are considered by the Sunnite Moslems to be canonical scriptures: 1. The Hadis of Mohammed Ismail al Buchari (d. 878). 2. Of Muslim ibn ul Hajaj (d. 883). 3. Of Abu Isa Mohammed al Tirmisi (d. 901). 4. Abu Daud al Sajistani (d. 897). 5. Of Abu Abd ur Rahmân al Nasâi (d. 925). 6. Of Abu Abdallah Mohammed Ibn Wajah (d. 895). None of these have ever been printed.

ARTHUR TWINING HADLEY,

PRESIDENT YALE UNIVERSITY.

Hadley, Arthur Twining, American college president: b. New Haven, Conn., 23 April 1856. A son of James Hadley (q.v.), he was graduated from Yale in 1876, and took graduate studies in political science at Yale and the University of Berlin. In 1879–83 he was a tutor at Yale, and during that time wrote for several journals, including the 'Railway Gazette' and the 'Financial Chronicle.' He was commissioner of labor statistics for Connecticut (1885–7), and was in 1885 a witness before the Cullom State committee which prepared the Interstate Commerce Law. In 1886 he became professor of political science at Yale, and in 1899 was made president of the university. He was president of the American Economic Association for two years. In 1885 he published 'Railroad Transportation: Its History and Laws,' which is everywhere recognized as one of the chief authorities on the subject, and has been translated into French and Russian; his other works include 'Report on the Labor Question' (1885); 'Economics, an Account of the Relations between Private Property and Public Welfare' (1896), presenting the theories of political economy in accordance with the most modern research and thought; and 'The Education of the American Citizen' (1901). His writings show him to be not only a scholar, but also a man of affairs well acquainted with the business world, and in this regard he is one of the best representatives of the modern type of university presidents.

Hadley, Henry K., American composer: b. Somerville, Mass., 1871. He was a pupil of S. A. Emery and G. W. Chadwick in Boston, studied also in Vienna, and in 1895 returned to the United States and was appointed instructor in music at St. Paul's School, Garden City, L. I. His symphony, 'The Four Seasons,' received the prizes given by the Paderewski Fund and the New England Conservatory of Boston. His works further include a concert overture 'Hector and Andromache'; a symphony, 'Youth and Life'; a cantata, 'In Music's Praise'; a festival march; trios, quartettes, and more than 150 excellent songs and pianoforte compositions.

Hadley, James, American philologist: b. Fairfield, N. Y., 30 March 1821; d. New Haven, Conn., 14 Nov. 1872. When a boy he suffered an injury to his knee, which developed seriously, and crippled him for life. He was graduated from Yale in 1842, took graduate studies in mathematics and also a theological course. In 1844 he was tutor at Middlebury College, Vt., and in 1845 became a tutor at Yale. In 1848 he became assistant professor of Greek there, and in 1851, professor of Greek. He was familiar not only with Greek, Latin, and the chief modern languages, but also with Hebrew, Arabic, Armenian, Gaelic, Irish, Sanskrit, Gothic, and Old English, and won a high reputation as a linguist distinguished for exactness and thoroughness in detail, united with breadth of view; he also was successful and influential as a teacher. He published a 'Greek Grammar' (1861), based on Curtius, and wrote the 'Brief History of the English Language' in the 1864 edition of Webster's 'Dictionary'; after his death, his 'Introduction to Roman Law' (1873) and 'Philological and Critical Essays' (1873) were published.

Hadley, John, English mathematician and astronomer: b. 1682; d. 14 Feb. 1743. He became a Fellow of the Royal Society in 1717, and was the inventor of Hadley's quadrant (see SEXTANT) and of a reflecting telescope (1723). The credit of having invented the sextant is claimed for Hadley, Godfrey, and Newton, but each seems, nevertheless, to have made his own discovery independently. Hadley described his instrument, which he called an "octant," to the Royal Society in May 1731.

Hadley, Mass., town, which includes several villages, in Hampshire County; on the Connecticut River and on the Boston & M. Railroad; three miles northeast of Northampton and four miles southwest of Amherst. It was settled in 1659, and was first called Norwottack; but in 1661, when it was incorporated, it was given the name Hadley, from Hadley in England. William Goffe and his father-in-law Whalley, who fled from England to America in 1660, and who lived for a time near New Haven, sought concealment in Hadley, in 1664, where Goffe died in 1679. According to tradition, when Hadley was at one time attacked by Indians, and the people were called from the meeting-house, they stood helpless until Goffe appearing, took the lead and repelled the enemy. Hadley is an agricultural region, and its industries are chiefly connected with farm products. Pop. (1900) 1,789.

Hadramaut, hä-drä-mât', Arabia, the name given to the coast region from Aden to Cape Ras-al-Hadd. It consists of a plateau, parted from a mountain chain, the barrier of the interior desert, by a complex of valleys. Commerce, agriculture, cattle-breeding, and the chase are the chief occupations. The climate is dry but healthy. Pop. about 150,000.

Hadrian, ha'drĭ-an (PUBLIUS ÆLIUS HADRIANUS), Roman emperor: b. Rome 24 Jan. 76; d. Baiæ 10 July 138. For his ardor in the study of Greek he earned the nickname of Græculus. A nephew of Trajan, he was adopted by that emperor, fought under him against the Dacians with some glory, and, having been entrusted with the praefecture of the East and the command of the Roman armies in the East early in 117 when Trajan left the field, Hadrian, upon Trajan's death later in the same year was made emperor by his soldiers. He quickly realized that he could make no forcible head against the simultaneous attacks of the Parthians and, in Dacia and Moesia, of barbarian foes, to say nothing of revolt in Syria and Egypt. With the true insight of a diplomat he foresaw that the extreme East must be either surrendered voluntarily or lost, and chose the former alternative as the least costly. Hence he gave up Armenia, Mesopotamia, and Assyria, all comparatively new Roman provinces, to the Parthian power, and withdrew the Roman eagles to the west of the Euphrates. In 119, for the purpose of becoming acquainted with the state of the provinces, he began his celebrated journey, which he is said to have performed chiefly on foot, marching bareheaded 20 miles a day and sharing cheerfully the hard fare of the humblest soldier. He visited Gaul, Germany, Britain, where he built the famous wall extending from the Solway to the Tyne, Spain, Mauritania, Egypt, Asia Minor, and

Greece, whence he returned to Rome after his circuit of the empire in 126 or 127 A.D., and received the title of "Pater Patriæ." Hadrian spent the years 132 and 133 in Athens, which city he adorned with splendid and costly buildings. After once more visiting Syria and crushing a desperate Jewish revolt, he returned to Italy, and spent the last years of his life at Rome and his villa. During his reign the army was vigorously disciplined and reorganized. As a civil ruler he merits high praise for the just and comprehensive view he appears to have taken of his duties as a sovereign. Hence to him is attributed, more than to any other, the consolidation of the monarchical system of Rome. Hadrian also divided Italy into four parts under four consuls, to whom was entrusted the administration of justice. Hadrian had a passion for building: his most splendid edifices were a famous villa at Tibur (now Tivoli), and in Rome the Aelian bridge, built in 136, and now styled the Pont Sant' Angelo. This bridge leads to the emperor's splendid mausoleum, the Moles Hadriani. He likewise laid the foundation of several cities, the most important of which was Adrianopolis. He was a lover of the fine arts and set a high value on Greek literature. No fragment of ancient literature has been more famous than the verses attributed to the dying Hadrian:

Animula vagula, blandula
Hospes comesque corporis
Quæ nunc abibis in loca
Pallidula, rigida, nudula,
Nec ut soles dabis jocos?

David Johnston, in his 'Translations, Literal and Free, of the Dying Hadrian's Address to his Soul' (1877), gives no fewer than 116 translations of all degrees of excellence. Among well-known writers, Byron, Prior, Pope, and Merivale have attempted renderings. Consult: Gregorovius, 'Der Kaiser Hadrian' (1884); Durr, 'Die Reisen des Kaisers Hadrian' (1881).

Hadrian's Wall, a wall in the north of England, called also the Roman Wall and the Wall of Severus. Before Agricola advanced into Scotland he established forts between the estuary of the Tyne and the Solway Firth, to protect him from attack in his rear. He adopted the same precaution before leaving the Lowlands of Scotland for the Highlands, placing encampments between the firths of Forth and Clyde. Afterward walls were constructed on these two lines. On the English side of the Border is a stone wall with a ditch on its north side. Attached to it are stationary camps, mile-castles, and turrets for the accommodation of the soldiery who manned it. To the south of the stone wall is a series of ramparts generally called the *vallum.* This fortification consists of three aggers or mounds and a ditch. The military way along which the soldiery moved lies between the *murus* or stone wall and the vallum. The wall was not intended as a mere fence to block out the Caledonians, but as a line of military strategy. Hadrian is now generally believed to have been the builder of the whole structure. Severus, however, repaired it before he advanced into Scotland. Agricola came to Britain in 78 A.D. Hadrian came toward the close of 119 A.D. Severus died in 211 A.D. Considerable portions of Hadrian's Wall yet remain. In two places the wall stands nine feet high. See Collingwood Bruce, 'The Roman Wall' (1851); and 'Handbook to the Roman Wall' (1863); Neilson, 'Per Lineam Valli' (1891); Creighton, 'Carlisle' (1889).

Hadrosaurus, hăd-rō-sâ'rŭs, **or Trachodon,** a genus of duck-billed dinosaurs of the Cretaceous rocks of North America. Compare CLAOSAURUS.

Haeckel, hĕk'ĕl, **Ernst,** German naturalist: b. Potsdam, Germany, 16 Feb. 1834. He studied at Berlin, Würzburg, and Vienna, taking his medical degree in 1858 and practising that profession a short time in the former city. During 1859 and 1860 he made a journey through Italy and Sicily in the interest of science, his work on 'The Radiata' (1862), being a result. Later portions were added in 1887 and 1888. In 1861 he settled in Jena for the study of comparative anatomy, but soon turned to the specific investigation of zoology, and after holding subordinate positions, was appointed in 1865 full professor at Jena. His researches had to do especially with the lower ranks of marine animals, and above all, with deep-sea life in its simplest forms. The material for such study was gathered from many and extended experiences in the North Sea, the Mediterranean, the Canary Isles, and the Indian Ocean. These travels and researches were the basis of works like the 'History of the Development of the Siphonophora' (1869); and 'Biological Studies' (1870). These, however, were introductory to greater representative works on natural philosophy and the development theory, such as 'Calcareous Sponges' (1872); 'Natural History of Creation' (1868), — which has received the honor of translation into twelve languages,— and his master work 'General Morphology of Organisms' (1866). More popular writings, making him known to a public much wider than the biologist ever addresses, are those 'On the Division of Labor in Nature and Human Life' (1869), 'On the Origin and Genealogy of the Human Race' (1870), 'Life in the Great Marine Animals'; 'The Arabian Corals' (1873); 'The System of the Medusa' (1880); and 'A Visit to Ceylon.' For many years he has devoted his attention to the deep-sea explorations of H. M. S. Challenger expedition, of which he has written voluminous reports in English. His general biologic conclusions regarding the life and growth of deep-sea organisms are given in his 'Plankton Studies' (1890), while his 'Monism as the Link between Religion and Science' may be considered as in a certain sense his confession of faith.

Hæmatemesis, hē-ma-tĕm'ĕ-sĭs, vomiting blood, which comes from the stomach, or œsophagus. It may result from alcoholism, poisoning, or cirrhosis of the liver. It is more frequent in later life than hæmoptysis (q.v.) but may occur in the acute perforating ulcers of the stomach in young women. It is frequently associated with cancer, but it results also from external violence.

Hæm'atin, or **Hem'atin.** See HÆMOGLOBIN.

Hæmatoxylin, hē-ma-tăx'ō-lĭn ($C_{16}H_{14}O_6$), the coloring matter of logwood, or *Hæmatoxylon Campechianum,* got from the extract by allowing it to stand some days in contact with ether, decanting, removing the ether, and adding water. Hæmatoxylin gradually deposits, and the crystals by pressure and recrystallization from water containing a little ammonium sulphite can be

got nearly colorless. Combined with three molecules of water it forms dimetric, with one of water trimetric crystals. The crystals are large, transparent, and brilliant, and have a sweet taste. Hæmatoxylin dissolves sparingly in water, but it is taken up very freely by solution of borax, by hypo-sulphite of sodium, phosphate of sodium, and some other salts. It is also soluble in ether and in alcohol. By acids it is not readily affected, but it reacts at once with alkalies, forming colored solutions, and with metallic oxides forming precipitates of various colors. By joint action of air and bases hæmatoxylin is oxidized and becomes transformed into hæmateïn.

Hæmaturia, hem-a-tū'rĭ-a, the presence of blood in the urine, which points to disease of the kidney or bladder. It is a symptom of some gravity. The treatment of the cause will probably remove this affection; in all cases complete rest is very important. See TREMATODA.

Hæmoglo'bin, or **Hemoglo'bin,** an organic coloring matter, which constitutes about nine tenths of the weight of dried red blood corpuscles, and serves as a carrier of oxygen from the lungs to the general tissues of the body. It is an exceedingly complex substance, and its formula is not certainly known. Zinoffsky gives it as $C_{712}H_{1130}N_{214}S_2FeO_{245}$; but this can hardly be regarded as more than a guess. According to many authorities, hæmoglobin is not a definite chemical compound, but a more or less variable mixture of simpler substances. It gives all the general reactions of the proteids, but, unlike most of the proteids, it may easily be obtained in crystalline form, its crystals commonly occurring in rhombic plates or prisms, varying somewhat in shape, according to the source from which the substance is prepared. The exceeding physiological importance of hæmoglobin depends upon the fact that it readily combines with oxygen to form a very unstable compound known as oxyhæmoglobin. The combination takes place as the blood corpuscles containing the hæmoglobin pass through the lungs; and the loosely-combined oxygen is given off again as the corpuscles pass through the capillaries, the oxyhæmoglobin being thereby again reduced to hæmoglobin. Hæmoglobin also combines with carbon monoxid to form a similar but far more stable substance known as carboxyhæmoglobin. In poisoning by the inhalation of coal-gas the carbon monoxid present in the coal-gas combines with the hæmoglobin in the lungs, and the carboxyhæmoglobin so formed does not break up again. As the absorption of the coal-gas proceeds, a continually increasing quantity of hæmoglobin is therefore destroyed, so far as its utility as an oxygen-carrier is concerned. In extreme cases of such poisoning, transfusion of blood is resorted to, in order that the patient may have a sufficient supply of hæmoglobin to transport the requisite quantity of oxygen from the lungs to the other tissues of the body.

The preparation of pure hæmoglobin is a difficult operation, and for its details reference should be made to Gamgee's 'Physiological Chemistry.' One of the best methods that have been proposed consists in adding to defibrinated blood about one sixteenth of its own volume of ether, and shaking the mixture. This treatment causes the red corpuscles to break up, and the fluid becomes lake-colored. After a time, varying from a few minutes to three days, according to the source of the blood, a heavy deposit of minute crystals of oxyhæmoglobin is thrown down. This may be purified by washing with 25 per cent alcohol, and subsequent recrystallization. Crystals of hæmoglobin itself have also been prepared. Pure hæmoglobin has a purplish color, which gradually passes into a scarlet or a yellowish red, as the substance absorbs oxygen and becomes thereby converted into oxyhæmoglobin. Carboxyhæmoglobin is even more brilliantly red than oxyhæmoglobin. All three of these substances exhibit marked absorption spectra when in solution, and very small quantities of them can be easily detected by the spectroscope. It is said that the presence of one part of hæmoglobin in ten thousand parts of water can be distinctly demonstrated by this means.

When oxyhæmoglobin is acted upon by acids or alkalies, or by the gastric juice, it is resolved into a proteid substance and a definite compound which has the probable formula $C_{68}H_{70}N_8Fe_2O_{10}$ and is known as hæmatin. Hæmatin may be best prepared by extracting blood clot, directly, with hot alcohol to which a small quantity of sulphuric acid has been added. The extract is next agitated with chloroform, which takes up the hæmatin. The chloroform is then separated, washed with water to remove the acid, and allowed to evaporate, when the hæmatin is deposited in the form of a bluish-black powder. Hæmatin is a very stable compound, and may be heated to 350° F. without decomposition. At higher temperatures it burns with evolution of hydrocyanic acid, leaving an ash composed chiefly of oxid of iron. It is insoluble in water, ether, dilute acids, and pure alcohol; but it dissolves readily in solutions of the caustic alkalies, and in alcohol to which a small quantity of sulphuric acid has been added. Consult Gamgee, 'Physiological Chemistry.'

Hæmophilia, a congenital inherited disease characterized by a tendency to obstinate bleedings. Women are very rarely affected, but transmission of the disease seems to be from the father through the daughters to the grandsons, and from father to son. The disease usually makes itself evident in early life, a slight wound being followed by abnormal hemorrhage, whereby the child becomes known as a "bleeder." The exact fault in nature's ordinary method in plugging blood-vessels has not been discovered; the shed blood will clot naturally. Besides the liability to excessive hemorrhage, these subjects are frequently afflicted with trouble in the joints, probably a chronic inflammation, the result of repeated small hemorrhages. Death is always imminent, as nothing can stop the flow of blood where large areas of the body are injured. Chlorides are used with some success for those mildly afflicted with the disease, particularly the chloride of calcium.

Hæmop'tysis, expelling blood from the lungs, larynx or bronchial tubes by coughing, which may be a symptom of phthisis. Morphine is useful immediately after such hemorrhages, but modern medicine rejects the use of styptics.

Hæmorrhoids (Greek, *haima*, blood, and *rheo*, to flow), literally, a flow of blood. Until the time of Hippocrates this word was used, conformably to its etymology, as synonymous with hemorrhage. It was afterward used in a

narrower sense, to indicate the flux of blood at the extremity of the rectum, and in some other cases which were considered analogous to it; thus it was applied to the flow of blood from the nostrils, the mouth, the bladder, and the uterus. It is at present used to signify a particular affection of the rectum, although the disease is not always attended with a flux; in this sense the affection is also called piles. Certain general causes may produce a predisposition to this disease; in some cases, it appears to be the effect of a hereditary disposition; in general, it manifests itself between the period of puberty and old age, although infants and aged people are not entirely exempt from its attacks. Men are oftener affected than women, in whom it is sometimes produced by local causes. It often shows itself in subjects who pass suddenly from an active to a sedentary life, or from leanness to corpulency. Any circumstance which produces a tendency to pressure on the venous return of blood in the pelvis is to be reckoned as a local cause. The accumulation of fæcal matter in the intestines as in habitual constipation; efforts to expel urine; the pressure produced by polypi; the obstruction of any of the viscera, especially of the liver; worms; use of drastic purges, particularly of aloes; long continuance in a sitting posture; riding on horseback; pregnancy; the accumulation of water by ascites;— such are some of the ordinary causes of hæmorrhoids.

Several varieties of hæmorrhoids are distinguished. They are known as external when apparent at the anus; internal when concealed within the orifice; blind or open, regular or irregular, active or passive, periodical or anomalous, etc. There is also a great difference in the quantity of blood discharged; it is usually inconsiderable, but in some cases is so great as to threaten the life of the subject. The quality, color, etc., of the blood, also differ in different cases. The number, seat, and form of the hæmorrhoidal tumors likewise present a great variety of appearances. When the disease is purely local it is cured more readily; but in the greatest number of cases it is connected with some other affection, or with the constitution of the subject. In these cases, if the piles are not troublesome on account of their size, or if the bleeding is not very considerable, cure of the primary affection should be attempted. The best mode of treatment is then to recur to hygienic rather than medicinal influences. The subject should avoid violent exercises, but moderate exercise will be found beneficial. The standing position is to be avoided as much as possible, especially following defecation. The constipation (q.v.) with which the subjects of this disease are liable to be affected should be remedied by hygienic dieting. If the pain is considerable, recourse should be had to sedatives and local application of hot water. If the disease appears under a more severe form, more violent remedies will become necessary. If the discharge of blood becomes excessive, particular care must be taken to regulate it. If the tumors acquire a considerable volume, surgical operations are necessary. At the present time the operative treatment of persistent hæmorrhoids is both safe and efficacious.

Hafiz, hâ-fîz', the pseudonym of MOHAMMED SHEMS ED DÎN, Persian poet: b. Shiraz in the beginning of the 14th century; d. 1388. The surname Hafiz was given him because he knew the Koran by heart. He was also called *Shakarlab* (Sugar-lip), from the flowing melody of his ghazals or short lyrics; and *Lissan Elghaïb* (the Mysterious Voice), from the deep mystic meaning said by his warmest admirers to be contained in many of his poems. He preferred independent poverty as a dervish to a life at court, whither he was often invited by Sultan Ahmed. He became a sheik or chief of a fraternity of dervishes, and died at Shiraz where a monument was erected to him, still frequently visited by pious Moslems. He is the greatest lyrical poet of Persia, and he furnishes the safest guide to Persian thought and manners. The songs of Hafiz were collected into a *Divan* (a Persian word for a collection of poems) after his death, which was first published at Calcutta in 1791, and translated into German by the celebrated orientalist Hammer-Purgstall (1812–13). A complete English translation by Clarke appeared in 1891. A critical edition of the Persian text, with scholia, etc., was published by Hermann Brockhaus (1854–61). Consult Horn, 'Geschichte der persischen Litteratur' (1901).

Hag-fish, a name given to the species of the families *Heptatremidæ* and *Myxinidæ Myxine*, and *Bdellostonia* of the class of Cyclostomi (q.v.). They are eel-like in shape, lack all paired fins, have a suctorial mouth, without jaws; a single nostril at the tip of the head and either one (*Myxine*) or from 6 to 14 (*Polistotrema*) gill openings along the sides of the body. Around the mouth are eight barbels, and the nostril connects with the cavity of the mouth. The skin contains numerous mucus-glands and also numerous pockets of "thread cells," the protoplasm of which is converted into long threads, which, when discharged, unwind and, together with the mucus, form a jelly-like mass protecting the animal. The eggs are large, oval in shape and enclosed in a horny case provided with hooks on each end by which they are anchored to sea weed, etc., on the bottom. Where abundant the hag-fishes are among the greatest pests of the fishermen. They attach themselves to other fishes in the neighborhood of the gills or on the eyes, and thence work themselves rapidly into the interior of the body, devouring the viscera, muscles, etc., so that there remains "a living hulk of head, skin and bones." The California hag-fishes (*Polistotrema Stouti*) will devour a fish of 10 or 15 pounds in a single night, and it is believed that they enter the fishes after they are taken in the nets. The hag-fish of the eastern coast (*Myxine glutinosa*) ranges north of Cape Cod, and in the European seas, south to the English Channel. Other species occur in other parts of the world.

Hagar, hā'gạr, an Egyptian handmaid in Abraham's house. She was presented by her mistress Sarah to Abraham, in order that Abraham might not die without descendants, Sarah herself being barren. Hagar bore Ishmael; but Sarah soon became jealous of her, and treated her severely. When Sarah bore Isaac, Hagar was sent away by Abraham, who, the Bible informs us, had received a divine order to dismiss her. She suffered much distress in the desert, but was relieved by an angel, and married her son to an Egyptian woman.

Hagen, Gotthilf, gŏt'hĭlf hä'gĕn, German hydraulic engineer: b. Königsberg, Prussia, 3 March 1797; d. Berlin 3 Feb. 1884. He studied at the University of Königsberg; in 1816 observed at Kulm the total eclipse of the sun, but later turned his attention from astronomy to engineering, and from 1831 to 1849 was professor of hydraulic engineering in the School of Engineering. The naval harbor of Wilhelmshafen, one of the strongest on the German Ocean, was built from his designs. In 1869 he became director of the Prussian building department. His most important work is his 'Handbuch der Wasserbaukunst' (1841–65), besides which he published numerous other volumes, including: 'Die Kanalisierung der obern Saar' (1866), and 'Untersuchungen über die gleichförmige Bewegung des Wassers' (1876).

Hagen, Theodor, tā'ō-dōr, German painter: b. Düsseldorf 24 May 1842. He became known through his landscapes of the Eifel Mountains and Westphalia, in 1871 was appointed professor in the Weimar art school, of which he was also director from 1877. In 1881 he resigned both posts and returned to Düsseldorf. He obtained a gold medal at the Berlin exposition of 1891. Among his works, distinguished by their forceful drawing and excellence of aërial perspective, are: 'The Kanderthal in Switzerland'; 'Sunset in the Siegenthal'; 'Spring Weather'; 'Swiss Landscape, with the St. Gothard Pass'; 'Town on the Lower Rhine — Evening.'

Ha'gerstown, Md., city, county-seat of Washington County, on Antietam creek, and on the Baltimore & O. the Cumberland V., the Norfolk & W. and the Western M. R.R.'s. Here are extensive manufactures of knit goods, bicycles, machinery, steam engines, lumber, etc. It is the trade centre of western Maryland and contains a court-house, high school, Bacon's School for boys and girls, electric light and street railways, three national banks, and an assessed property valuation of $7,000,000. Pop. (1900) 13,591.

Haggadah, ha-gä'da, one of two rabbinical biblical interpretations forming the Midrash (q.v.).

Haggai, hăg'ī, the tenth of the minor prophets, and first of those who prophesied after the captivity. He was born in Babylon, and joined the first band of exiles who, on the issue of the decree of Cyrus (536 B.C.) returned to their own land. He was buried among the priests at Jerusalem, as belonging to the family of Aaron. The book of Haggai consists of four distinct prophecies and has but one theme, the building of the second temple. The brevity of the several prophecies is so great, and the poverty of expression which characterizes them so striking, as to give rise to an idea that in their present form they are but the outline or summary of the original discourses. They were delivered in the second year of Darius Hystaspes (520 B.C.), at intervals from the first day of the sixth month to the twenty-fourth day of the ninth month in the same year. The closing prediction foreshadows the establishment of the Messianic kingdom upon the overthrow of the thrones of the nations.

Haggard, hăg'ard, **Andrew Charles Parker,** English novelist: b. Bradenham Hall, Norfolk, 7 Feb. 1854. He is a brother of H. R. Haggard (q.v.) and besides serving with distinction in the English army has published 'Dodo and I'; 'Polyglot Poems'; 'Under Crescent and Star'; 'Love Rules the Camp,' and other books.

Haggard, Henry Rider, English novelist: b. Bradenham Hall, Norfolk, England, 22 June 1856. At 19 he went as secretary to Natal, and served on the staff of Theophilus Shepstone during his mission to the Transvaal in 1877. In 1884 he was admitted to the bar of Lincoln's Inn, but has devoted his time mainly to authorship and agriculture. His novels of South African life have attained a wide popularity both at home and in the United States. Among his works are: 'Cetewayo and His White Neighbors' (1882); 'Dawn' (1884); 'The Witch's Head' (1885); 'King Solomon's Mines' (1886); 'Jess' (1887); 'She' (1887); 'Allan Quatermain' (1888); 'Colonel Quaritch, V. C.' (1888); 'Cleopatra' (1889); 'Beatrice' (1890); 'Montezuma's Daughter' (1894); 'Doctor Therne' (1898); 'History of the Transvaal' (1900); 'Lysbeth' (1901); 'Rural England' (1902); 'A Gardener's Year' (1905); etc.

Haghe, Louis, loo-ē häg, Belgian painter and lithographer: b. Tournai 17 March 1806; d. London 9 March 1885. At first an architect, he turned to landscape painting, in 1832 went to London, there as a lithographer entered partnership with William Day, then became interested in water-color painting, and in 1873–84 was president of the New Water Color Society. He painted by preference old Flemish interiors, such as 'Audience Chamber at Bruges,' but also scenes from English history ('Cromwell with the Letter of Charles I.'), and other subjects. In oils he was less successful. He worked entirely with his left hand.

Hagiographa, hā-jī-ŏg'ra-fa, a Greek word, signifying sacred writings, first introduced by Epiphanius as the rendering of the Hebrew word *Ketubim* = writings. The third and last great division of the Old Testament books, the others being Torah (the Law) and Nebiim (the Prophets). The three-fold division is alluded to in the New Testament, the several parts being described as "the law" or "Moses," "the Prophets," and "the Psalms" (Luke xxiii. 44). In this passage the Psalms are the Hagiographa. When the division is twofold, the Law and the Prophets, the Hagiographa are merged in the second category (Matt. v. 17, xi. 13). In our present Hebrew Bibles the Hagiographa consist of 13 books thus arranged: Psalms, Proverbs, Job, Song of Solomon, Ruth, Lamentations, Ecclesiastes, Esther, Daniel, Ezra, Nehemiah, and I. and II. Chronicles, but the list is otherwise drawn up by many authorities.

Hagonoy, hä-gō-noi', Philippines, a pueblo of the province of Bulacán, island of Luzon, on the Grande de la Pampagna River, about three miles from Manila Bay, seven miles southwest of Malolos. Lake Hagonoy is partly within the precincts of the town; this lake dries up in the summer season, so that the lake bed can be cultivated. Pop. 20,100.

Ha'good, Johnson, American soldier: b. Barnwell, S. C., 21 Feb. 1829; d. there 4 Jan. 1898. At the beginning of the Civil War he entered the Confederate army and in 1862 he

came a brigadier-general. He fought against Gillmore at the siege of Charleston (1863), and was commander of Battery Wagner. With his brigade he participated in the battle of Cold Harbor, and subsequently was in the trenches at Petersburg. He took part also in the operations north of the James after the surrender of Fort Harrison, and commanded Bragg's rear guard at Fort Fisher.

Hague, hāg, **Arnold,** American geologist: b. Boston 3 Dec. 1840. He was graduated at the Sheffield Scientific School of Yale (1863); studied three years at the universities of Göttingen and Heidelberg, and in 1867 was appointed assistant geologist on the United States geological exploration of the 40th parallel. His published works are: 'The Volcanoes of California, Oregon, and Washington Territory' (1883); 'The Volcanic Rocks of the Great Basin' (1884); 'The Volcanic Rocks of Salvador' (1886); 'Crystallization in the Igneous Rocks of Washoe'; 'Geology of the Yellowstone National Park' (1899).

Hague, George, Canadian financier: b. Rotherham, Yorkshire, Eng., 1825. In 1854 he went to Canada, where in 1856–76 he was connected with the Bank of Toronto. Subsequently he became general manager of the Merchants' Bank. He was also elected first president of the Canadian Bankers' Association and of the Montreal Good Government Association, and made generous gifts to various charities.

Hague, The (Holland), one of the chief towns, practically the capital of the kingdom, 33 miles southwest from Amsterdam, 16 miles northwest of Rotterdam, within 3 miles of the sea. It is the residence of the queen and of the foreign ambassadors, and the seat of the States-General of the Netherlands, and of the principal part of the central administration of the kingdom. Among the most important structures are the royal palace, in the Nordeinde, the palace of the Prince of Orange, the palace of Prince Frederick of the Netherlands; the Binnenhof, a large irregular building, founded in 1249, and containing the hall of assembly of the States-General, and various government offices, the provincial government-house, a large roomy edifice; the town-hall; the ministry of justice; the municipal museum, containing pictures and antiquities; the royal library, containing 500,000 volumes, besides valuable collections of medals and cameos; a cannon foundry, one of the largest and most conspicuous buildings in the town, colonial office, war office, the national monument, erected to commemorate the restoration in 1813 of Dutch independence. There are many other monuments to attract attention, particularly the equestrian statue of William I. of Orange, in front of the royal palace, and the figure of Shinoya, placed opposite the house in which he lived, etc. The royal collection of pictures, in the Prins Mauritshuis, embraces a picture gallery chiefly confined to Dutch masters. The parks, gardens, markets and suburbs of the city are famous for their beauty and interest. The special educational facilities of the city are excellent, and there are good public schools. There are also many learned societies in the city, among which may be mentioned The Hague Society for the Defense of the Christian Religion, the Witte Society, the Physics Society and the Netherland-India Institute. The Hague is not a manufacturing or commercial city, its chief revenue being derived from the throngs of foreigners who visit the city and watering place on the coast.

The origin of The Hague may be traced to the building of a hunting seat here of the counts of Holland in 1250. It is the birth-place of William II., prince of Orange, and William III., prince of Orange and king of England. Here was held the International Peace Congress in 1901–2. Pop. (1900) 199,285.

Hague Court, The, a permanent tribunal for international arbitration established as a result of The International Peace Conference, held in May, June, and July 1899 at The Hague, the governmental seat of the Netherlands.

The Hague International Peace Conference was one of the most important events which marked the close of the 19th century, and has been justly styled "the first great parliament of Man". The Conference assembled in response to a rescript issued by Czar Nicholas II. of Russia, 24 Aug. 1898, inviting to a conference all governments with representatives accredited to the Imperial Court. The Conference was to occupy itself with the great problem of universal peace, especially through the international diminution of armaments by land and sea, and the prevention of armed conflicts by pacific diplomatic procedure. The invitation was accepted by all the governments to whom it was tendered, and the first meeting for the Conference was fixed for 18 May 1899 at The Hague,— the capital of the Netherlands being selected, as stated by the Russian minister of foreign affairs, because "His Imperial Majesty considered it advisable that the Conference should not sit in the capital of one of the Great Powers where so many political interests centre that might impede the progress of a work in which all the countries are equally interested". The Conference was held at the celebrated Huis ten Bosch — House in the Wood,— the members assembling in the historically decorated Orange Hall. Each nation was represented by prominent diplomats, jurists, men of affairs, soldiers, and sailors, the representatives of the United States being Ambassador Andrew D. White, Minister Newel, General Crozier of the army, Captain Mahan of the navy, Seth Low, mayor of New York, and F. W. Holls of the New York bar. The president of the Conference was Baron de Staal of the Russian delegation.

Three committees were formed to deal respectively with disarmament, regulations in warfare, and mediation and arbitration. The final act of the Conference, signed 29 July 1899, comprised three conventions or treaties embodying the results arrived at by the committees. The first and most important was the Convention for the Peaceful Adjustment of International Differences by the permanent institution of a Court of Arbitration in the midst of the independent powers, accessible to all. The second convention dealt with the laws and usages of war on land, and the third convention provided for the adaption to naval warfare of the principles of the Geneva Convention of 1864. Regulations also prohibited the throwing of projectiles and explosives from balloons; the use of projectiles intended solely to diffuse deleterious and asphyxiating gases (this was not accepted by the United States and Great Britain); and the use of soft expansive bullets. The last two conventions embodied the wisest and most humane principles of military conduct resulting from a study and dis-

cussion of these matters during the half-century preceding, and which had their first codification in the "Instructions for Guidance of the Armies of the United States" issued at the beginning of the Civil War.

The Convention for the Peaceful Adjustment of International Differences, however, was the crowning work of the Conference, and was a source of much gratification to the advocates of international arbitration, as bringing to fruition a sentiment which for centuries had hoped for the establishment by the nations of the earth of some permanent form of congress or court, which should be vested with functions to insure the preservation of peace and to deliver the world from the strife and carnage with which it had been afflicted in all the past ages.

During the last decade of the 19th century peace advocates had been persistent in their advocacy of a permanent court of arbitration. In 1894, at its meeting in Holland, the Interparliamentary Union, a voluntary organization of members of the national legislative bodies of the nations, adopted a declaration in favor of a permanent court of arbitration; and in 1896 resolutions to the same effect were unanimously adopted in the United States at the annual Mohonk Conference on international arbitration, and by the New York State Bar Association, the latter presenting to the President of the United States a memorial setting forth a permanent tribunal as the essential feature of any general scheme of arbitration. The honor of presenting such a proposition in The Hague Conference fell to Lord Pauncefote, chairman of the British delegation; Germany was antagonistic, but the sentiment was so strongly in its favor that the German delegates were induced to withdraw their objection, and provision was made for its consummation. The fourth division of the Convention in 47 articles provides for the creation of the Court, defines its jurisdiction and the principles which are to guide it, specifies the manner in which its members are chosen, the rules governing its procedure, its awards, and other necessary details. The Convention provides that each of the 26 signatory powers shall appoint for a term of six years as members of the Permanent Court not more than four persons "of recognized competence in questions of international law, enjoying the highest moral reputation." These persons constitute a Permanent Court of Arbitration, accessible at all times and acting in accordance with the prescribed rules of procedure; they do not, however, sit as a collective body, but when two or more nations have a case to submit to arbitration, they select by mutual agreement one, three, or five members, who will act as the tribunal to try the case. Thus it happens some members of the Court may never be called upon to discharge the functions of a judge. Also, although The Hague is designated as a place where the Court shall hold its sessions, another place may be designated by agreement of the litigant parties. Under the presidency of the Dutch minister of foreign affairs, the diplomatic agents of the signatory powers, in residence at The Hague, constitute a permanent council which serves as the office of the Permanent Court of Arbitration. The first cases adjudged by the Court were the Pious Fund Claim between Mexico and the United States in 1902, and the difficulties of Venezuela with the United States and various European nations in 1903.

For the erection of a Temple of Peace comprising a comprehensive library of international law, and a courthouse which could be used as a meeting place for the Permanent Court of Arbitration, Andrew Carnegie on 25 April 1903 donated the sum of $1,500,000 to be administered by the Government of the Netherlands as trustee for the other signatory powers of The Hague Convention of 29 July, 1899. Consult Foster, "Arbitration and The Hague Court" (1904); Holls, "The Peace Conference at The Hague" (1900); Penfield, "Some Problems of International Arbitration" (1904).

Hahn, hän, **August,** German Protestant theologian: b. Grossosterhausen, Saxony, 27 March 1792; d. Breslau, 13 May 1863. He studied at Leipzig, and was appointed in 1819 professor extraordinary of theology at Königsberg. In 1826 he became professor of theology at Leipzig, and in 1833 was called to Breslau, and in 1844 became general superintendent of the Province of Silesia. Among his best known works are his Hebrew Bible (1831) and his 'Bibliothek der Symbole und Glaubensiegeln der Apostolisch-Katholischen Kirche' (1842, 2d ed. 1878).

Hahnemann, hä'nĕ-män, **Samuel Christian Friedrich,** German physician; founder of the homœopathic system: b. Meissen 10 April 1755; d. Paris 2 July 1843. In 1775 he went to Leipsic, where, against his father's will, he studied medicine, and found the means chiefly by the translation of English medical works. At a later period he went to Vienna, and after some years he returned and completed his studies at Erlangen. He afterward practised medicine at various places, but gave it up for a time, until, in 1789, by the translation of Cullen's 'Materia Medica,' he was led to adopt a new method of cure. His system was fully explained in his 'Organon der rationellen Heilkunde' (1810). In 1820 the government prohibited him from dispensing medicines, and thereby, from his inability to have them prepared by druggists, obliged him to give up his practice. Duke Ferdinand of Anhalt-Köthen, however, gave him an asylum at Köthen, and conferred upon him the title of Hofrath. Here he remained till 1833, when he proceeded to Paris, where he hoped to find a wider sphere for his operations. The result equaled his expectations; and a royal decree issued in 1835 authorized him to practise homœopathy. Among his works should be named 'Dictionary of Materia Medica,' his 'Essays on Poisoning by Arsenic, and on the Effects of Coffee,' and his treatise on 'Chronic Affections.' Consult: 'Life and Letters,' by Bradford (1895). See HOMŒOPATHY.

Haidarabad, hī-da-ra-bäd'. See HYDERABAD.

Hail, small masses of ice or frozen rain falling from the clouds in showers or storms, varying in their form, being either angular, pyramidal, or stellated; as well as in their consistency, being sometimes as hard as ice and sometimes as soft as snow. The theory that the formation of hail is dependent on the presence of whirlwind phenomena in the upper atmosphere, has gained considerable acceptance. The formation of the alternate coatings of ice and snow is, on this theory, produced by a series of vortical ascents and descents to and from an upper snow region and a lower region where the temperature is rather higher.

Hail Columbia, a national song of the United States. The words written during a period of great political excitement in 1798, by Judge Joseph Hopkinson, were set to the melody of the 'President's March,' composed the same year in honor of President Washington, by Pfyles, orchestral leader at the John Street Theatre, New York. The composition first sung at a theatrical benefit attained great popularity, and on account of its patriotic sentiments has become a representative national song.

Hail Mary, Ave Maria, or **Angelical Salutation,** a prayer consisting of three parts: the first, the words by which the angel addressed the Blessed Virgin (Luke I. 24) with the word Mary after "Hail"; the second, the words by which Elizabeth addressed Mary (Luke I. 42), to which has been added the word Jesus; the third, the words: "Holy Mary, Mother of God, pray for us sinners now and at the hour of our death — Amen." The name, "Angelical Salutation," comes from the first part of the prayer, which is the salutation of the angel. The first and second parts, taken from the Bible, were in use in their present form in early times; but the words of the third part were varied until the 16th century when the present form was approved and adopted by Pope Pius V. The prayer is in general use among Roman Catholics and is found in many Anglican books of devotion.

Hailes, Lord. See DALRYMPLE, SIR DAVID.

Hai'leybury College, England, an institution at Hailey, near Hertford, 20 miles north of London, founded by the East India Company in 1806, as a training school for admittance to the service of the company. It attained a high reputation, and numbered among its alumni, the most distinguished names connected with the Indian administration of the 19th century. After the Indian Mutiny of 1857–8, and the government reorganization of the Indian Civil Service, the college was closed for four years. It was reopened under a royal charter in 1862 as a public school, and while maintaining many of the traditions of its famous predecessor is no longer an Indian service training ground. Handsome modern buildings have been added to the old college quadrangle, built in 1809; the surrounding grounds cover nearly 100 acres. Consult: Lowell, 'Colonial Civil Service' (1900); Monier-Williams, 'Memorials of Old Haileybury College' (1894).

Hailmann, hāl'man, **William Nicholas,** American educator: b. Canton Glarus, Switzerland, 20 Oct. 1836. He studied at the medical college of Louisville, Ky., was director of the German-American Seminary at Detroit in 1878–83, in 1894–8 was national superintendent of Indian schools, and in 1898 became superintendent of instruction at Dayton, Ohio. Among his writings are: 'History of Pedagogy' (1870); 'The Application of Psychology to Teaching' (1887); 'Place and Development of Purpose in Education' (1899).

Hair, strictly speaking, the peculiar epidermal covering of the body in mammals, although by analogy the term is loosely applied elsewhere, as to the setæ of annelids, the slender modified spines of caterpillars, etc. Hair is present in every mammal, although the amount may be greatly reduced so that in certain whales it occurs only in the fœtal stage, in others is limited to two bristles on the lips. The structure is best understood by following the development. In the earliest stage (Fig. 1) there is merely a thickening of the Malpighian layer of the epidermis (see SKIN) at the points where the hair is to be found. This thickening increases in amount, and thus forms a solid plug (Fig. 2) which projects into the underlying

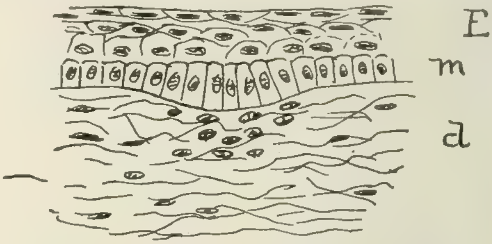


FIG. 1.—SECTION THROUGH THE EARLIEST STAGE OF HAIR FORMATION.

E, epidermis, showing in *m*, the Malpighian layer, the elongation of the cells; *d*, derma, with proliferation of cells to form the papilla shown in Fig. 2.

derma. At the same time the cells, which are scanty in most parts of the derma, become abundant beneath the ingrowing plug, and form the basis of the future papilla. Next a ring-shaped pit appears on the outer surface of the plug and gradually becomes deeper, cutting the epidermis into two parts, an outer root-sheath and an inner rod-like part, the hair itself, while

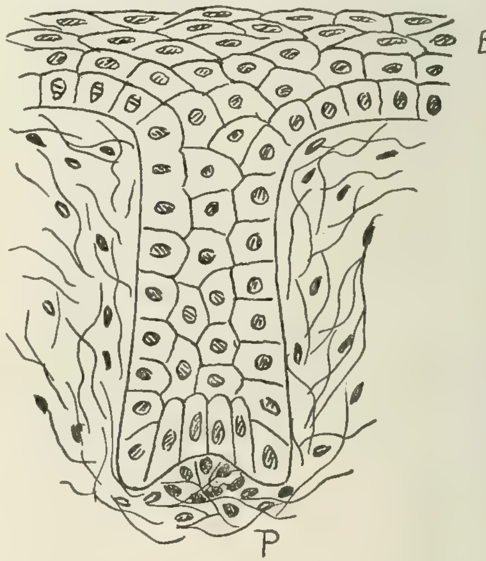


FIG. 2.— SECOND STAGE IN HAIR FORMATION.

The epidermis, *E*, has now formed a solid plug extending down into the derma; the papilla, *P*, has begun to form at the apex of the epidermal ingrowth.

the pit forms the follicle (see Fig. 3). The papilla grows into the base, bearing blood-vessels, while the Malpighian layer at this point forms the tissue from which the hair grows. In the hair itself several parts are recognized — a central pithy axis, the medulla; next, a layer of

cells, the cortex, and outside this, forming the outer surface of the hair, the cuticle. Farther down in the follicle is the inner root-sheath, formed of two layers of cells known respectively by the names of the two anatomists, Henle and Huxley, who first described them. The Malpighian cells, at the base of the follicle, divide continually, and the new cells thus formed are pushed outward and are transformed into the hair. From this it will be seen that the hair is not a secretion but is composed of cornified cells. It is also apparent that the hair is not hollow.

The differences between the different kinds of hair are largely those of shape and of the amount of the various parts present. Thus in many animals two kinds of hair occur, longer and coarser hair on the outside, and beneath this a closer and softer under-fur. The coarser hairs may be enlarged into bristles, or still more enlarged to form spines, like those of the porcupines and hedgehogs. Again the hairs may become united to each other, the result being the formation of scales like those of the pangolins or horns like those of the rhinoceros. In some

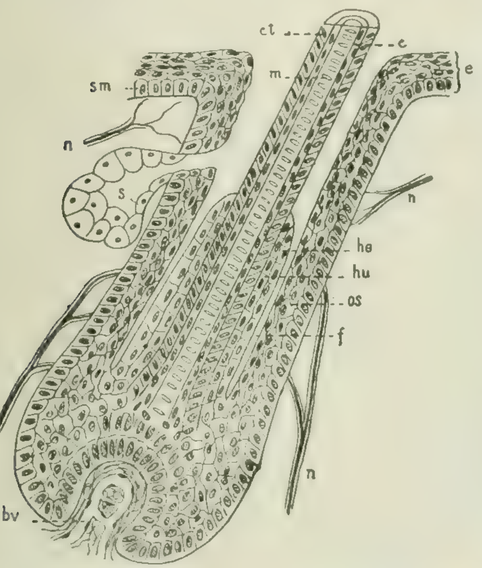


Fig. 3.— Diagrammatic Section of Hair and Hair Follicle.

bv, blood vessel; *c*, cortex; *ct*, cuticle; *e*, epidermis; *f*, follicle; *he*, Henle's layer; *hu*, Huxley's layer (*he* and *hu* making up the inner root-sheath); *m*, medulla; *n*, nerve; *os*, outer root-sheath; *s*, sebaceous gland; *sm*, Malpighian layer of epidermis.

cases the hair is perfectly straight, again it may be curly. The straight hairs are circular in section, the curly are flattened, the amount of curl being proportional to the amount of flattening. Certain hairs (wool of sheep, etc.) have the property of felting. This depends upon the scale-like projections of the cells of the cuticular layer. The color of the hair is due to the presence of pigments belonging to the group of melanins.

Several accessory structures (Fig. 5) are connected with the hair: sebaceous glands which empty an oily substance into the follicle to keep the hair in a moist, soft condition; nerves which are distributed to the wall of the follicle and thus render the hairs to a certain extent organs of touch, as in the whiskers (*vibrissæ*) of cats; and muscles for the erection of the hair (*erectorespilæ*). This erection may be to increase the warmth of the body by entangling a layer of air among the hairs, or it may have the purpose of protection against injury, either by terrifying some enemy or by affording a loose envelope around the body some distance from

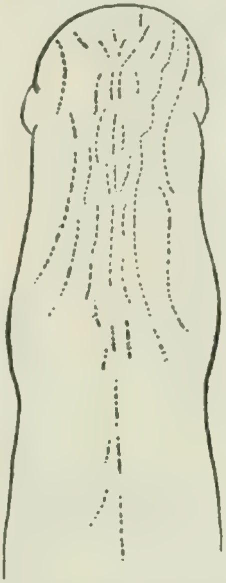


Fig. 4.— Hair tracts on the back of an embryo cat (after Maurer).

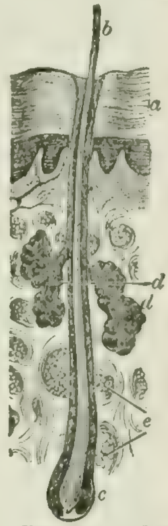


Fig. 5.— A Hair. Vertical section of skin, showing hair-follicle and related parts: *a*, epidermis; *b*, hair; *c*, hair-bulb; *d*, *d*, oil-glands; *e*, fat-cells.

the flesh. Usually the hair is shed (molted) at regular intervals, but there are exceptions, as in the mane and tail of horses, as well as in the case of man. The hair is not scattered irregularly over the body but occurs with more or less regular arrangement. In the early embryos it is not uncommon to find it distributed in regular lines (Fig. 4). Later the lines become broken up into groups of hairs, the arrangement being characteristic of the species, but without any broad morphological significance. It should be noted that although hair and pin-feathers closely resemble each other in general appearance they are very distinct structures, hair originating in a thickening of the epidermis, while feathers (q.v.) like scales are dermal in origin. Most of the literature relating to the hair is in German. Consult the writings of Maurer, Meigerle, Weber, and Poulton, 'Quarterly Journal of Microscopical Science,' Vol. XXXVI. (1894).

J. S. Kingsley,
Professor of Zoology, Tufts College.

Hair-dressing. As the hair is the greatest ornament of the human body, the arrangement of it has always been one of the most important duties of the toilet. The ancient Hebrews esteemed fine hair a great beauty, as several passages of Scripture show. The Hebrew women plaited their hair, confined it with gold and silver pins, and adorned it with precious stones. Herodotus informs us that the ancient Egyptians

let the hair of the head and beard grow only when they were in mourning. Even in the case of young children they were wont to shave the head, leaving only a few locks on the front, sides, and back. The women, however, wore their natural hair long and plaited, often reaching down in the form of strings to the bottom of the shoulder-blades. A practice the very opposite seems to have prevailed among the ancient Assyrians, as regards men at least. In the Assyrian sculptures the hair always appears long, combed closely down upon the head, and shedding itself in a mass of curls on the shoulders. The beard was also allowed to grow to its full length. To the Greeks the hair was an object of great importance, and they devoted much time to it. Homer regularly applies to the Greeks an epithet denoting that they had ample flowing locks.

The Athenians curled their hair, and fastened it up with small golden ornaments shaped like grasshoppers, in token of their being "sons of the earth." Gold, pearls, precious stones, flowers, and ribbons were employed to ornament the tresses, and nets were also worn. False hair seems to have been latterly used, and in great quantities, both curled and frizzled. Married women were distinguished from the unmarried by the manner in which the hair was parted in front. The Romans generally wore no covering on their heads except at sacred rites, games, festivals, and in war. Women in later times wore great quantities of false hair, and dyeing the hair was common. They were particularly addicted to frizzling and curling their hair, raising it into stories of curls, some of great height. Long hairpins were used to fix the curls. Arranging the hair was a matter of great importance. Slaves frizzled and adjusted it, and a number of females learned in the art of the coiffeur superintended the process, while the fair dame herself watched the growing edifice of curls, gold, precious stones, crowns of flowers, in a mirror of polished steel, brass, tin, or silver.

On the introduction of Christianity the apostles preached against the prevailing fashion of dressing the hair. St. Paul regarded it as a shame for a man to have long hair, though the reverse for a woman. It then became common for men to cut the hair short; hence the clergy soon wore the hair quite short, and afterward even shaved their heads in part. In the time of Francis I., king of France, long hair was worn at court; but the king, proud of his wound on the head, himself wore short hair, in the Italian and Swiss fashion, which soon became general. In the reign of Louis XIII. the fashion of wearing long hair was revived, and as it became desirable to have the hair curling, the wigs were also restored.

Among the Anglo-Saxon women the custom prevailed of parting, curling, and turning the hair over the back. Anglo-Saxon men wore their hair long at the time of the Norman invasion, while the conquerors adopted the singular fashion of shaving the back of the head. Under Elizabeth, false hair was greatly worn, padded with cushions, under-propped, with forks, wires, etc., and adorned with gold, pearls, and precious stones. It is well known that the gallants of Charles I.'s time wore their hair in long flowing locks, while the closely-cropped hair of the Puritans brought the name of Roundheads down upon them. In the Queen Anne era, while the ladies wore their hair long, they generally tied it in a knot, and almost completely covered it up by extravagant head-dresses of wire and paste-board, or feathers and ribbons. At that time, and for long after, the coiffure of a lady was such a serious affair, and the hair-dressers were so fully employed, that fair wearers were often compelled to have that part of their toilet done two days before a ball, and pass the night on a chair for fear of disturbing the elaborate arrangement. This was the period of the prevalence of whitening the head with hair-powder, a preparation of pulverized starch and perfume. The custom of wearing it was introduced from France into England in the reign of Charles II. To make the powder hold, the hair was usually greased with pomade. In 1795 a tax was put upon the use of hair-powder in Great Britain, and at one time yielded $100,000 per annum, but the result was that hair-powder fell out of general use, and the French Revolution, which overturned so many antiquated customs, further contributed to throw it into disfavor. The chignon was introduced and had its day of popular favor in the 19th century, bringing back the fashion of false hair and padding to a greater or less extent. With respect to men's hair, short cutting is now universal, long hair being considered as a sign of slovenliness or eccentricity.

Hair Manufactures, the industries by which the hair of animals is employed in the production of commercial articles of ornament or utility. The strongest and most durable of haircloth is woven from the tails of horses. The horsehair from the mane is twisted into ropes and after being boiled and then dried in an oven is untwisted and in a half-matted condition employed for stuffing beds and cushions. The hair of cows is employed as a binder for plaster; in Europe it is sometimes woven into carpets, or hose. The Chinese use pig's hair for the same purposes. The stiff hair, or bristles from the ridge of the hog's back, are made into brushes, for the hair, teeth, or nails; as well as into brooms, and the larger painting and whitewashing brushes. Human hair is used for wigs, toupees and frisettes. See WIG.

Hair Pencil, in painting, a fine brush made of the hairs of the camel, sable, badger, squirrel, marten, raccoon, goat, etc. The various sizes require the quills of the crow, pigeon, goose, turkey, or swan. Hair pencils are used by artists in water colors, and by house and sign painters in fine work.

Hair-tail. See SCABBARD-FISH.

Hair-worm. See EELWORM.

Hairless Dogs. Several races of domestic dogs are bred in the warmer parts of the world, whose skins are nearly hairless. In China and Farther India a large dog of this description, called polygar, is used in hunting. Central Africa has a breed resembling a small black greyhound. A hairless dog is found mummified in prehistoric Peruvian tombs, and others were formerly prevalent in the West Indies, or is still known in Mexico. These have been cultivated by fanciers in the United States, and constitute a recognized show class. They are small and terrier-like, brownish or bluish-black, wrinkled,

MAIN STREET, PORT-AU-PRINCE, HAITI.

and have only a few straggling hairs on the body, with sometimes a tuft on the head.

Haiti, Hayti, or **Santo Domingo,** the second largest island of the West Indies, lying between Cuba and Porto Rico, the principal adjacent islands being La Gonave, at the entrance of Port-au-Prince, Tortuga Island, before Port de Paix, and Vache Island, before Cayes. The whole island is about 638 kilometres long with a surface of 75,074 square kilometres. It comprises two republics: the Republic of Haiti in the west and the Dominican Republic (q.v.) in the east, with a total population of 1,700,000. The land is very fertile, being irrigated by 47 rivers; 14 mountain chains are spread over the island. The mines are still to be worked and there is a large field for investment. Haiti is healthful. From June to September it is hot in the lowlands; but regular land and sea breezes moderate the temperature. In the mountains it is always cool. There is a dry and a wet season. There are no poisonous snakes or insects. The sanitary condition is excellent.

When, on 6 Dec. 1492, Columbus discovered Haiti, the island was divided into five states or "cacicats." The inhabitants, called Indians, had an easy life and were ruled by chiefs whose title was "cacics." The natives could not stand the hard work imposed on them by the Spaniards; they died rapidly. Then began the import from Africa of the black slaves. The Spaniards enjoyed alone their new possession until 1630, when the French adventurers known as "buccaneers" and "freebooters," after occupying Tortuga Island, undertook the conquest of what became St. Domingue.

From the intercourse between white and black, resulted in St. Domingue an intermediary class, the mulattoes. Most of the latter, on account of their relationship, were not slaves; and their black mothers, their relatives, and other slaves who could own enough money to redeem themselves, little by little obtained their freedom. These free colored people were not allowed any political rights. They at first did not resent it. They endeavored to become land-owners.

When the French Revolution broke out in 1789 these free men or "affranchis," who by that time had accumulated wealth, asked for equality of political rights. The Assemblée Nationale granted them those rights. But the French landlords or "colons" were not at all pleased to have the colored people for their fellow citizens. A hard struggle began. The "colons" called the English to their rescue.

At the end of the year 1793, the English took possession of a part of the island. St. Domingue was considered lost to France, being occupied partly by the Spaniards, partly by the English, when Toussaint Louverture (q.v.) espoused the cause of France. This extraordinary man, who, up to 40 years of age, was a slave, revealed himself a great general and a first-class statesman. He succeeded in ridding the country of the Spaniards and in expelling the English, who, after an occupation of about five years, were compelled to abandon their prey. The French government rewarded him by appointing him major-general and governor of the island. Later on, Napoleon I. thought that Toussaint Louverture was too powerful. In 1801 he appointed his brother-in-law, Gen. Leclerc, governor of St. Domingue, and sent a formidable army to reduce the authority of Louverture. Toussaint Louverture, after a few skirmishes, surrendered and retired on one of his properties. Nevertheless, Gen. Leclerc caused him to be arrested and deported to France in June 1802; to that end the French general resorted to treachery.

The colored people took up arms against the French domination in September 1802 under the leadership of Gen. Dessalines. The fight was very severe. And at the end of the year 1803, Rochambeau, who, at the death of Gen. Leclerc, was in command of the French army, hard pressed in the city of Cape Haiti by the black troops, was compelled to capitulate. And on 1 Jan. 1804 Haiti proclaimed its independence, with Gen. Dessalines as its first ruler. Slavery was abolished. Haiti was then the first country to rid humanity of such a sad practice.

In 1822 the Spanish part came under the administration of Haiti; and the whole island was ruled by one government. But in 1844 the Spanish part seceded and established an independent government, known to-day as the Dominican Republic.

The Republic of Haiti is administered by a president, elected for seven years, by the House of Representatives and the Senate assembled in "Assemblée Nationale." The president is assisted by six ministers or secretaries of state. The House of Representatives is elected by the people for three years, and the Senate is elected by the House of Representatives for six years; but every two years the third part of the Senate is renewed.

The judiciary organization consists of a supreme court (Tribunal de Cassation) of civil, criminal, correctional courts, and of justices of the peace.

Education is compulsory and gratuitous. The primary as well as the high schools are freely open to all. Haiti devotes now a sixth of its revenues to education.

French is the language of Haiti, though the country people speak a patois called "creole."

The religion of the people is Roman Catholic. There are an archbishop, three bishops, and in every commune at least a priest. The pope entertains a diplomatic representative, a legate, at Port-au-Prince, and Haiti has a minister accredited to the Holy See. Freedom of conscience is, however, guaranteed; and all cults are protected. Haitian citizens only can own real estate. Any foreigner may easily be naturalized.

Haiti produces coffee, cocoa, logwood, mahogany, and cotton; tortoise-shells, all kind of cabinet wood, hides, honey, bees-wax, etc., are also exported; for home consumption, they make sugar, rum, soap, straw hats, pottery, matches, artificial ice, etc. There is a railroad from Cape Haiti to Grande Rivière and another one from Port-au-Prince to "L'Etang." These railroads are managed by Haitian companies; so are the inland telegraph and telephone lines. The area of the Republic is estimated at 26,000 square kilometres and the population (1900) 1,294,400.

J. N. Léger,
Envoyé Extraordinare et Ministre Plénipotentiaire d'Haiti aux Etats-Unis.

Hake, Alfred Egmont, English journalist and author. He is a son of Thomas Gordon Hake (q.v.) and cousin of General C. E. Gor-

don (q.v.), whose life he has written in 'The Story of Chinese Gordon' (1883). Other works by him are: 'Paris Originals' (1878); 'Flattering Tales' (1882); 'The Unemployed Problem Solved' (1883); 'Events in the Taiping Rebellion' (1891); 'Suffering London' (1892); 'Gordon in China and the Soudan' (1896); 'Irish Finance' (1897).

Hake, Thomas Gordon, English poet and physician: b. Leeds 1809; d. London 11 Jan. 1895. He took his medical degree at Glasgow University in 1831, and practised his profession in East Anglia, later becoming the physician and friend of Dante Gabriel Rossetti. His poetry is thoroughly original, but very subtly philosophical. His works include: 'Poetic Lucubrations' (1828); 'Vates: A Prose Epic' (1839); 'Madeline with Other Poems and Parables' (1871); 'New Symbols' (1875); 'Maiden Ecstasy,' verse (1880); 'The Serpent Play, a Divine Pastoral' (1883); 'Memoirs of Eighty Years' (1892).

Hakes, Fishes of the family *Gadidæ* and chiefly of the genera *Phycis* and *Merluccius,* distinguishable from the cod and haddock by having only two dorsal fins. *Phycis* has a chin barbel and filamentous ventral fins, both of which are lacking in *Merluccius.* The squirrel-hake (*Phycis chuss*) and white hake (*P. tenuis*), both also called ling or codling, are common bottom fish on our Atlantic coast from Virginia northward. The silver hake or whiting (*Merluccius bilinearis*) has a similar range, but is less common in shallow waters and leads a roving life in search of herrings and other smaller fishes. Various other species occur in the North Atlantic and Pacific Oceans. The hake fishery is of considerable extent, and the product is salted and sold chiefly as boneless cod. The dried air-bladders are utilized in the manufacture of isinglass.

Hakim, ha-kēm', a Turkish word, signifying lord and frequently in the Koran applied to Allah, God, as in the Greek and English versions of the Jewish Scriptures the word Lord is used for Jehovah. It is now-a-days especially given as a title of honor to the imperial physician of the Sultan, who is Hakim bashi, that is to say, the chief of the physicians, always a Turk; whilst the physicians in the seraglio under him are western Europeans, Greeks and Jews.

Hakluyt, hăk'loot, **Richard,** English geographer: b. about 1553; d. London 23 Nov. 1616. He entered Christ Church College, Oxford, in 1570, and became so eminent for his acquaintance with cosmography that he was appointed public lecturer on that science. In 1582 he published a small collection of voyages and discoveries, forming the basis of a subsequent work on a larger scale. In 1584–88 he was in Paris as chaplain to Sir Edward Stafford. On his return he published (in 1589) his famous collection of 'The Principal Navigations, Voyages, and Discoveries of the English Nation, made by Sea, or over Land, within the Compass of these 1500 Years.' The first volume of a new edition of his great work was published in 1598, the second and third in 1599 and 1600. In 1602 he became prebendary, and in 1603 archdeacon, of Westminster, and next year he was appointed a chaplain of the Savoy. He was interred in Westminster Abbey. He published several other geographical works, among them 'Virginia Richly Valued, etc.' (1609), a translation from the Portuguese. An edition of his chief work appeared in 16 vols. 1885–90. The manuscript papers of Hakluyt were used by Purchas in his 'Pilgrims.'

Hakluyt Society, of Great Britain, organized in December 1846, for the purpose of printing and distributing among its members rare volumes on voyages and travels, and geographical records. Between 1847 and 1900 fully 100 volumes were issued under the editorial supervision of eminent authorities. Among these publications were: 'Select Letters of Columbus' (1849); Raleigh, 'Guiana' (1848); and 'Danish Arctic Expedition' (1897).

Halbig, Johann, yō'hän häl'bĭg, German sculptor: b. Donnersdorf, Lower Franconia, 13 July 1814; d. Munich 29 Aug. 1882. He studied at the Munich Academy, and elsewhere, finally establishing himself at Munich, where he became a professor in the Polytechnic School in 1845. His most important work is the quadriga with four colossal lions for the triumphal gateway, Munich. He also executed the Platen memorial at Ansbach, the bronze statue of Fraunhofer at Munich, the 'Emancipation' group in New York, the 'Crucifixion' group for Oberammergau, and numerous busts.

Haldeman, hâl'dē-man, **Samuel Stehman,** American naturalist: b. Locust Grove, Pa., 12 Aug. 1812; d. Chickies, Pa., 10 Sept. 1880. He was educated at Dickinson College, Pa., was professor of natural sciences at the University of Pennsylvania in 1851–5; and of comparative philology there 1869–80. He published 'Fresh-Water Univalve Mollusca of the United States' (1840); 'Zoological Contributions' (1842–3); 'Elements of Latin Pronunciation' (1851); 'Affixes in Their Origin and Application' (1865); 'Pennsylvania Dutch' (1872); 'Outlines of Etymology' (1877); 'Analytic Orthography' (1858); etc.

Hal'dimand, Sir **Frederick,** Swiss soldier in the English service: b. Canton of Neuchâtel, Switzerland, October 1718; d. Yverdun, Switzerland, 5 June 1791. He served in the army of Sardinia and in that of Prussia under Frederick the Great, later became a member of the Swiss guard at The Hague, and was there stationed when with Henry Bouquet (q.v.) he enlisted in 1756 in the British army for service in America. He organized, largely from Pennsylvania, a regiment composed of Swiss, Germans, and others and known as the 'Royal Americans,' and became its commander. In 1759 he won distinction by his successful defense of Oswego against the attack of 4,000 French and Indians, in 1767–73 commanded the garrison at Pensacola, Fla., and assisted Gage in the siege of Boston. From 1778 to 1784 he was governor of Canada, severely repressed Canadian sympathy with the Revolution, and offered an asylum to royalist refugees. His valuable official correspondence is in the possession of the British Museum. Upon his return to England actions for false imprisonment were successfully brought against him.

Hale, Charles Reuben, American Protestant Episcopal bishop: b. Lewiston, Pa., 14 March 1837; d. Cairo, Ill., 25 Dec. 1900. He

COURTESY OF THE BOOKLOVERS MAGAZINE. Copyright by Davis & Sanborn.

EDWARD EVERETT HALE.

was graduated at the University of Pennsylvania in 1858; entered the Episcopal ministry and in 1892 was made assistant bishop of Springfield, Ill., with the title of Bishop of Cairo. He was an authority upon matters pertaining to the Greek Church and his writings, all of a very scholarly cast, mainly relate to the history, liturgies and customs of that communion.

Hale, Edward Everett, American Unitarian clergyman and author: b. Boston, Mass., 3 April 1822. His father was Nathan Hale (q.v.), the first editor of the Boston *Daily Advertiser*, and the son was educated at the Boston Latin School and Harvard College. Later he studied theology and after being licensed to preach in 1842 was pastor of the Church of the Unity, Worcester, Mass., 1846–56. He then became pastor of the South Congregational Society in Boston, a Unitarian Church, and has been its pastor emeritus from 1901. In the Unitarian body he has long been one of its foremost men, and of a radical rather than a conservative type, while yet strongly loyal to the Unitarian faith. As a preacher he has always been popular, and his talents for organization have borne fruit in such humanitarian societies as the Harry Wadsworth Clubs, King's Daughters, Look Up Legions, and others. For several years he edited 'Old and New,' a magazine afterward merged in 'Scribner's Monthly,' and has edited 'Lend a Hand,' a journal of organized charity, since 1886. Since his retirement from active pastoral work he has been active in various denominational and other religious and social enterprises, and still continues to preach and lecture at frequent intervals. His 80th birthday was celebrated by a gathering in Symphony Hall, Boston, composed of representative persons from all denominations in his native city, as well as of civic and state officials, assembled to testify to the regard in which he was held, irrespective of creed or race. To Americans in general, however, he is best known as an author, and in spite of his countless clerical labors he has been one of the most voluminous of American writers. Much of his work is from necessity ephemeral in its nature, but when he has consciously wrought with an artistic end in view his level of attainment has been high. His short story, 'The Man Without a Country,' has long been accounted an American classic, and even more skilful in construction and perfect in finish, 'My Double and How he Undid Me,' and 'In His Name' have been almost equally popular. In extravaganzas like 'The Brick Moon,' such an absolute air of verisimilitude is preserved that the absurdest conceptions of the tale appear more than half credible. 'The Man Without a Country' was indeed accepted as a record of fact by many readers on its first appearance in 1863, although the theme is in its conception most improbable, and its author was obliged to state at a later date that it had no foundation in fact. The list of his published works is a long one, including nearly 70 titles and besides those already named may be cited 'Margaret Percival in America' (1850); 'Elements of Christian Doctrine' (1860); 'If, Yes, and Perhaps' (1868); 'Sybaris and Other Homes' (1869); 'The Ingham Papers' (1869); 'His Level Best and Other Stories' (1872); 'Philip Nolan's Friends' (1876); 'The Fortunes of Rachel' (1884); 'Boys' Heroes' (1886); 'Life of George Washington Studied Anew' (1887); 'They Saw a Great Light' (1889); 'The Story of Christopher Columbus' (1891); 'The Story of Massachusetts' (1891); 'The New Harry and Lucy' (1892); 'East and West or the New Ohio' (1892); 'A New England Boyhood' (1893); 'Fifty Years: Poems' (1893); 'If Jesus Came to Boston' (1894); 'Susan's Escort' (1895); 'Historic Boston' (1898); 'Lowell and His Friends' (1899); 'Memories of a Hundred Years' (1900). With his sister Susan Hale (q.v.) he has written a series of travel books entitled 'Family Flights through France, Germany, etc.,' and he has also edited numerous volumes from 'The Rosary' (1848) to 'Unpublished Essays of Emerson' (1895).

Hale, Eugene, American politician: b. Turner, Oxford County, Me., 9 June 1836. After study of law he was admitted to the bar in 1857, began practice at Ellsworth, Me., and was a member of the Maine legislature in 1867, 1868 and 1880. In 1868 he was elected representative to Congress, and in that capacity served until 1878, acting on the committee on appropriations, and during his last term being chairman of the Republican congressional committee. In 1868, 1876 and 1880 he was a delegate to the Republican national conventions of those years, in 1874 was offered the post of postmaster-general and in 1877 that of secretary of the navy, but declined both. He was a member of Grant's commission appointed for canvass of the Louisiana presidential vote in 1876. He succeeded Hannibal Hamlin in the United States Senate in 1881, and was re-elected in 1887, 1893, 1899 and 1905. In the Senate he became known as a Republican leader, interesting as a speaker and skilful in matters of legislative routine.

Hale, George Ellery, American astronomer: b. Chicago 29 June 1868. He was graduated from the Massachusetts Institute of Technology in 1890, studied also in the Harvard observatory and at Berlin, was professor of astrophysics at Beloit College in 1891–3, lecturer in astrophysics in Northwestern University, 1891–3, and was associate professor of astrophysics in the University of Chicago in 1892–7. In 1896 he became director of the Yerkes Observatory (Williams Bay, Wis.) of the university, and in 1897 professor of astrophysics. He edited the 'Astrophysical Journal' from 1895, and published papers on stellar spectroscopy and other subjects.

Hale, Horatio, American ethnologist: b. Newport, N. H., 3 May 1817; d. Clinton, Ontario, 29 Dec. 1896. He was a son of Sarah J. Hale (q.v.). He was graduated from Harvard in 1837 and the next year was appointed philologist to the government exploring expedition under Captain Wilkes, and was thus enabled to study the languages of the Pacific Islands, North and South America, Australia, and Africa. The results of his observations were published in 'Ethnography and Philology' (1846). He then studied law, was admitted to the Chicago bar, and removing to Canada in 1855 practised law at Clinton. His other works are: 'Indian Migrations as Evidenced by Language' (1883); 'The Iroquois Book of Rites' (1883); 'A Report on Blackfoot Tribes' (1885). He was classed among the foremost philologists of his

time and was a member of learned societies at home and abroad.

Hale, Irving, American soldier and electrician: b. North Bloomfield, N. Y., 28 Aug. 1861. He was graduated from the United States Military Academy in 1884, was assigned to the engineer corps, was instructor in engineering at the Military Academy in 1888–9, and in 1890 resigned from the army. He became manager of the General Electric Company for the district comprising Utah, Wyoming, Colorado, and New Mexico, with headquarters at Denver; upon the outbreak of the Spanish-American war was appointed colonel of the 1st regiment of Colorado volunteers, was promoted brigadier-general for distinguished service in the Philippines, and later brevetted major-general. In 1899 he was honorably discharged from the volunteer service. His writings include papers on electrical subjects in scientific and engineering journals and in the proceedings of the Colorado Scientific society.

Hale, John Parker, American legislator and diplomat: b. Rochester, N. H., 31 March 1806; d. Dover, N. H., 19 Nov. 1873. After graduation from Bowdoin in 1827 and study of the law at Rochester and Dover, he was admitted to the bar in 1830, in 1832 was elected a Democratic representative in the State legislature, and in 1834–41 was United States district attorney. In 1842 he was elected to Congress, where, though remaining a Democrat, he stoutly opposed the "gag-rule" which sought the exclusion of anti-slavery petitions. He was renominated; but previous to the election the annexation of Texas was made a plank of the Democratic platform, and the State legislature of New Hampshire directed its congressmen and senators to support the measure. Hale in a public statement refused to do this and the Democratic State Convention was then reassembled and his name stricken from the ticket. Hale ran as an independent Democrat, but no candidate received a majority. In 1846, after a spirited canvass known as the "Hale storm of 1845," he was elected to the lower house of the legislature, and became its speaker. In 1847 he was elected to the United States Senate, where he was the first, and, until joined by Salmon P. Chase in 1849, the only avowed anti-slavery member. He was an orator of fine abilities, and besides opposing the slave system, secured laws abolishing flogging and grog-ration in the navy. He was nominated for president by the Free-Soil Democrats in 1852, and received 157,685 votes. In 1855 he was elected to the Senate for the four years of the unexpired term of C. G. Atherton, deceased, and in 1858 for a full term. During the Civil War he supported the Lincoln administration. He was United States minister to Spain in 1865–9.

Hale, Lucretia Peabody, American author, sister of E. E. Hale (q.v.): b. Boston, Mass., 2 Sept. 1820; d. there 12 June 1900. She was very popular as a writer for young people, and in addition to 'The Lord's Supper and Its Observance' (1866); 'The Service of Sorrow' (1867); 'The Wolf at the Door' in the 'No Name Series' (1877), she published for young readers 'The Peterkin Papers' (1882), and 'The Last of the Peterkins' (1886). She also wrote 'The New Harry and Lucy' (with E. E. Hale). She will be longest remembered as the creator of the Peterkin Family, who have become widely recognized types of character.

Hale, Sir Matthew, English jurist: b. Alderley, Gloucestershire, 1 Nov. 1609; d. there 25 Dec. 1676. He was educated at Oxford and Lincoln's Inn, and is said to have studied 16 hours daily, extending his researches to natural philosophy, mathematics, history, and divinity, as well as the sciences more immediately connected with his profession. He was called to the bar before the commencement of the civil war; and in the conflict of parties which took place his moderation, accompanied as it was by personal integrity and skill in his profession, secured him the esteem of both royalists and parliamentarians in his own time. In 1654 he became a judge of the Common-bench (the former King's-bench), in which station he displayed firmness of principle sufficient to give offense to the Protector. He was a member of the parliament which restored Charles II., and one of the members most active in passing the Act of Indemnity. In 1660 he was knighted, and made chief baron of the Court of Exchequer. He was the last English judge who sanctioned the conviction of culprits for witchcraft. He was raised to the chief-justiceship of the King's-bench in 1671. After his death appeared his 'History of the Pleas of the Crown'; 'Jurisdiction of the Lords' House'; and 'The History of the Common Law of England. He also wrote several works on scientific and religious subjects.

Hale, Nathan, American revolutionary officer: b. Coventry, Conn., 6 June 1755; d. New York 22 Sept. 1776. He was graduated at Yale in 1773, and engaged as a teacher, first at East Haddam, and afterward at New London. His parents intended him for the ministry; but on the Lexington alarm in 1775 he wrote to his father, in a Connecticut regiment, saying "that a sense of duty urged him to sacrifice everything for his country," and soon after entered the army as lieutenant (1775) and in a few months was promoted to be captain (1776). While with the troops near Boston he was vigilant and faithful in every point of duty; and according to a tradition of doubtful authenticity, in September 1776, when in New York, he, with an associate, planned and effected the capture of a British sloop laden with provisions, taking her at midnight from under the guns of the man-of-war Asia, and distributing her prize goods to the American soldiers. After the retreat of the army from Long Island, when it was all-important to understand the plans of the enemy, Washington applied for a discreet and practised officer to enter the enemy's lines and procure intelligence, and Hale volunteered for the service. He passed in the disguise of a Dutch schoolmaster to the British camp and made full drawings and memoranda of all the desired information, but on his return was apprehended and taken before Howe, by whom he was ordered to execution the next morning. He was denied a Bible and the aid of a clergyman; and was hanged, saying with his last breath: "I only regret that I have but one life to lose for my country." A statue of Hale is in City Hall Park, New York. Consult the 'Life' by Johnston (1901); Holloway, 'Nathan Hale, the Martyr Hero' (1899).

Hale, Nathan, American journalist: b. West Hampton, Mass., 16 Aug. 1784; d. Brookline, Mass., 9 Feb. 1863. He was a nephew of the patriot Nathan Hale (q.v.) and father of E. E. Hale (q.v.). He was graduated from Williams College in 1804, and after studying law was admitted to the Boston bar in 1810, in 1811–4 was editor of the Boston 'Weekly Messenger,' and in 1814 purchased and became editor of the *Advertiser,* established in 1813 and the first New England daily. At first Federalist in politics, the *Advertiser* became successively Whig and Republican and was at all times very influential. In 1820 it opposed the Missouri bill, in 1854 the Kansas-Nebraska bill, and it was the first newspaper to advocate the settlement of Kansas by "Free-Soil" colonists. Hale was a founder of the 'North American Review' (1815), served at various times in both houses of the Massachusetts legislature, published a series of stereotyped maps after a method invented by himself (1830), and wrote pamphlets on topics of internal improvement.

Hale, Philip, American music critic: b. Norwich, Vt., 5 March 1854. Graduated from Yale in 1876, he was admitted to the bar in Albany (1880), studied music under Dudley Buck and later in Europe with Haupt, Bargiel, and Guilmant (1885–7), and was organist successively of Saint Peter's, Albany (1879–82), Saint John's, Troy (1887–9), and the First Unitarian Society of Roxbury, Mass. (1889). In 1889–97 he contributed music criticism to the Boston press, from 1891 was critic of the *Journal,* in 1897 became editor of the 'Musical Record,' and in 1901 of the 'Musical World.' He is known as one of the most discriminating and interesting of American writers on musical subjects.

Hale, Salma, American politician: b. Alstead, Cheshire County, N. H., 7 March 1787; d. Somerville, Mass., 19 Nov. 1866. He was early apprenticed to a printer of Walpole, N. H., in 1805 became editor of the 'Political Observer,' a Republican journal of Walpole, held various local offices, and in 1828 and 1844 was a member of the New Hampshire house of representatives, and in 1824 and 1845 of the State senate. In 1845 he was appointed secretary of the commission for the determination of the northeastern boundary line of the United States. He was elected to Congress in 1816 as a Republican (Democratic) representative, but declined a re-election. His 'History of the United States' (1821) won a prize of $400 and a gold medal, offered by the American Academy of Belles-Lettres, and appeared in many subsequent editions. He published also 'The Administration of J. Q. Adams' (1826); and 'Annals of the Town of Keene' (1826).

Hale, Sarah Josepha Buell, American author and editor: b. Newport, N. H., 24 Oct. 1788; d. Philadelphia 30 April 1879. Her husband dying in 1822 leaving her with five small children, she supported her family by literary work. She was editor of the Boston 'Ladies' Magazine' 1828–37, and when in 1837 this was consolidated with 'Godey's Lady's Book,' published in Philadelphia, she became editor of the latter also, continuing in the position for forty years. She retired from literary life in 1877. Her efforts in behalf of the Bunker Hill Monument fund, her interest in seamen, in foreign missions, and in the higher education of women, were untiring and successful. For many years she advocated the keeping of Thanksgiving Day as a national festival, as it has been observed since 1864, when President Lincoln adopted her suggestion. Her most enduring publication is 'Woman's Record: or Sketches of All Distinguished Women' (New York 1874).

Hale, Susan, American author and watercolorist: b. Boston 5 Dec. 1833. She has published 'Life and Letters of Thomas Gold Appleton' (q.v.) (1885), and with her brother, E. E. Hale (q.v.) has written the popular 'Family Flight' series of travel books for young people.

Hale, William Bayard, American writer: b. Richmond, Ind., 6 April 1869. He was graduated from Harvard and the Episcopal Theological School (Cambridge, Mass.), and was rector at Middleborough, Mass., 1892–9, and subsequently at Ardmore, Pa., retiring from the ministry in 1901. He has published 'The Making of the American Constitution'; 'The Eternal Teacher' (1895); 'The New Obedience' (1898); 'Phillips Brooks'; etc.

Hale, William Thomas, American writer: b. Liberty, Tenn., 1 Feb. 1857. He practised law for several years and has since been connected editorially with St. Louis and Tennessee journals. He has published 'Poems and Dialect Pieces' (1894); 'Showers and Sunshine,' verse (1896); 'The Backward Trail' (1899); 'An Autumn Lane and Other Poems' (1899); 'Great Southerners' (1900).

Halévy, Jacques François Fromental Elie, zhäk frän-swä frō-mōn-täl ā-lē ä-lā-vē, French composer: b. of Jewish parentage, Paris 27 May 1799; d. Nice, France, 17 March 1862. He studied counterpoint under Cherubini for five years, and in 1819 was sent to Italy to finish his education. The first of his pieces performed was a little comic opera, 'L'artisan,' given at the Théâtre Feydau, in 1827. His chef d'œuvre, 'La Juive,' appeared in 1835, and rapidly obtained a European celebrity, and has been frequently sung in the United States. Among his other works are 'L'Eclaire'; 'Guido et Ginevra'; 'La Reine de Chypre'; 'Le Val d'Andorre'; 'La Fée aux Roses.' The melodies of Halévy are always soft and flowing, the harmony correct and pleasing; but his works display on the whole more talent than genius.

Halévy, Joseph, zhō-zĕf, French Orientalist and traveler: b. Adrianople, Turkey, 15 Dec. 1827. In 1868 he traveled in Abyssinia; and for the Académie des Inscriptions he traversed (1869–70) Yemen, where he obtained copies of not less than 686 inscriptions, largely Himyaretic and Sabæan. He was appointed assistant librarian of the Asiatic Society, and adjunct-professor of Ethiopic in the Ecole des Hautes Etudes. Well known also as a Biblical critic and Assyriologist, he founded (1893) the 'Revue Sémitique d'épigraphie et d'histoire ancienne,' and published numerous works, including: 'Archæologic Mission to Yemen' (1872); 'Journey to Nedjran' (1873); 'Sabæan Studies' (1875); 'The Origin of Babylonian Civilization' (1876); 'Miscellany of Criticism and History Regarding Semitic Peoples' (1883).

Halévy, Ludovic, lü-dō-vēk, French dramatist and novelist: b. Paris, France, 1 Jan. 1834.

He is a nephew of J. Halévy (q.v.) and, unsuccessful at first, he finally worked his way into public favor, especially after associating his pen with that of Henri Meilhac. In collaboration with the latter, he wrote many of the librettos of Offenbach's most brilliant and satiric operettas, including 'The Perichole,' 'The Brigands,' the 'Belle Hélène,' and 'The Grand Duchess of Gérolstein.' Several serious librettos of high excellence are from the same hands, including that for Bizet's 'Carmen.' In spoken drama, Frou-Frou' and 'Tricoche and Cacolet' are among the most popular plays the two dramatists produced together. In 1881 he ceased writing for the stage, and turned to fiction. 'L'Abbé Constantin,' the first of his novels, is also the most popular, and opened to him the French Academy. It was for more than one season the French story of the day. It is a charming story, full of fresh air and sun, simply and skilfully told. It presented a view of American character and temperament not usual in French fiction; and irreproachable in its moral tone, has become a sort of classic for American schools and colleges. 'La Famille Cardinal' (The Cardinal Family) and 'Crichette' are studies in fiction of aspects of Parisian life. 'Notes and Souvenirs' embody observations during the Prussian invasion of 1871. They are interesting, as giving faithful pictures of the temper of the people during those days. Among his short stories, 'Un Mariage d'Amour' (A Marriage for Love) is one of the best.

Half Blood, in law, the relationship of persons born of the same father but not of the same mother, which is called a consanguinean relation; or of those born of the same mother but not of the same father, which is termed uterine. In the succession to real or landed property a kinsman of the half blood inherits next after a kinsman of the whole blood in the same degree, and after the issue of such kinsman when the common ancestor is a male, but next after the common ancestor when such ancestor is a female. So that brothers consanguinean inherit next after the sisters of the whole blood and their issue; and brothers uterine inherit next after the mother.

Half-breeds, the children of parents of different races; a term usually confined to whites and American Indians. There are two tribes of Indian half-breeds, at Red River Settlement, chiefly employed in agriculture and hunting. The rise of independent half-breed tribes is "the first step toward the evolution of a distinct race."

Half-caste, a person born of a European father and a Hindu or Mohammedan mother, or more rarely of a Hindu or Mohammedan father and a European mother; an East Indian.

Half-crown, a British silver coin of the value of two shillings and sixpence (60 cents).

Half-dollar, a silver coin of the United States of the value of 50 cents. Authorized in April 1792, its coinage at a weight of 208 grains was begun in 1794; its issue was suspended from 1798 to 1800 inclusive and in 1816. In 1853 its weight was reduced to 192 grains. The half-dollar is legal tender to the amount of ten dollars.

Half-eagle, a gold coin of the United States of the value of five dollars, so called from the national emblematic bird which figures upon the reverse. Authorized in 1792 the coinage was begun in July 1795; there was no issue in 1816 and 1817.

Half-King, the name given by the English to a Seneca Indian, chieftain of an Ohio tribe, who accompanied Washington during his expeditions in 1753–54, and was present at the defeat of the French at Great Meadows. His summary of the prowess of the respective combatants was that "the English acted like fools and the French like cowards."

Half Moon, the name of the vessel commissioned by the Dutch East India Company in 1609, and commanded by Henry Hudson for a voyage of exploration in search of a Northwest Passage. In this ship he entered New York Bay and explored the river which bears his name.

Half-tones, pictures produced by printing from plates made by the half-tone process, which will here be described. Except that used in line-drawing, until early in the eighties there was no process by which paintings, wash-drawings, or photographs could be done into the form of a surface printing-block for the press, and the introduction then of the half-tone block marked a revolution in the history of photographic illustration. The development of the process was the result of a kind of evolution of Bullock's (1866). Meisenbach of Munich patented a half-tone process in 1882.

The American Frederic Eugene Ives and others have since experimented and published results, and by them within a few years the process as it now exists was practically established. Americans were first in the field with an improved device for breaking up the image into dots, which was so much superior to anything invented in Europe that almost every other method was dropped in its favor. The diamond-ruled screen, which was introduced in this country by Max Levy, is essential to advanced work in half-tone. To make one of the screens, a sheet of the finest plate-glass is coated with a varnish of asphalt and wax, and placed on the bed of an automatic ruling-machine capable of ruling lines of any fineness up to 500 to the inch. The cutter is diamond-pointed and gauged to cut lines of any desired width. The lines are ruled diagonally at 45° across the glass, the number to the inch varying as required. The ruled surface is treated with hydrofluoric acid, which eats into or etches the lines laid bare by the diamond and forms a channel which is filled up with an opaque pigment. This enamel is baked in the lines in an oven, and then the surface is polished until the lines are perfectly level and the spaces represented by the clear glass are bright and transparent. Two of these ruled glasses are required for each screen, laid together with the lines crossing at right angles and cemented with Canada balsam.

To produce a half-tone block from a picture, wash-drawing, or photograph, this ruled grating is placed in front of the sensitive plate, not in contact with it, but at a distance which must be nicely determined by experience. Everything is represented by dots so accurately graded in relation to the light and shade of the original that the eye scarcely detects them, and the half-tone picture appears as a practical *facsimile* of the original from which it was photographed.

Most half-tone blocks are now etched on copper, and the sensitizing solution generally employed for this metal is a compound of fish-glue, albumen, chromic acid, water, and bichromate of ammonia. The copper is cleaned with tripoli and washed: the sensitizing solution is flowed over it two or three times; it is placed on a revolving table and rapidly whirled to spread the coating thinly and evenly; the coating is dried by gentle heat in a yellow-lighted room, and the plate is now ready for exposure under the half-tone negative. Three to ten minutes' exposure to an electric arc-light completes the printing, then the plate is given a bath in cold water, and is soaked and washed under a spray of water until the compound not acted upon is dissolved out. The image on the metal at this stage is almost invisible. To facilitate an examination of the film, the plate is dipped into a solution of methyl-violet, which stains the film and brings the picture into view. If all is right, the surface is dried either by flowing it with methylated alcohol or by gentle heat. The next operation is the hardening of the glue-picture into a substance resembling enamel — hence the "enameline process." The plate is highly heated over the flame of a large Bunsen burner; during the progress of this "burning in" or enameling, the blue picture gets pale, then gray, and vanishes; as the plate gets hotter, the image appears as a faint brown, and increases in strength to a rich chestnut-brown tint, when the heat must be withdrawn, and the plate cooled off. The plate has now upon it a picture formed of a strong, hard, impermeable coat of enamel which will bear any reasonable etching without further protection.

The etching-bath is made up of neutral perchloride of iron dissolved in water, and of a strength which registers 35° with a Baumé's hydrometer. The plate is first subjected to a general etching, so that it may be inked over with a printer's roller, and a first proof of the photo-etched picture be pulled in the press. The dulling of the general effect caused by the interposition of the necessary screen-grating has to be removed as far as possible, and this is done by artists who are specially trained for the work. The parts of the picture which are in shadow and are usually correctly rendered by a properly exposed negative are covered over with varnish, and the next tones are etched again; then these tones are covered up and the high lights are treated until the resulting picture, when proofed, correctly represents the original. The plates are then trimmed by engravers, beveled to admit of being riveted to the wood-mounts, and are mounted type-high for use in the printing-press.

Invention and experiment are now active toward the next great step in half-tone work, the production of surfaces without the mechanical smoothness hitherto so persistent. What is aimed at is the making of pictures which are free from mechanical effect, and are yet sufficiently delicate in texture to retain the finer details.

Half-way Covenant, a concession in church requirements made by the New England Synod convened at Northampton in 1657, whereby persons who had been baptized in their infancy, who assented to the doctrines of faith, entered into covenant with the church, and led decent and respectable lives, were admitted to the privileges and prerogatives of church-membership with the exception of the Lord's Supper, although they might give no evidence of conversion and had neither the ability nor willingness to make profession of religious experience. This "half-way covenant" as it came to be called aroused bitter controversy which did not die out until the 19th century; among its most strenuous opponents were Jonathan Edwards and his followers. The contention is baseless that it entailed certain civil privileges in relation to the State franchise, its chief aim being to admit children to baptism and to transmit to them the same degree of church membership as their parents. Consult Walker, 'Creeds and Platforms of Congregationalism' (1893).

Haliburton, hăl'ĭ-bėr-tȯn, **Thomas Chandler,** Canadian humorist: b. Windsor, Nova Scotia, December 1796; d. Isleworth, near London, 27 Aug. 1865. He practised law in Halifax, and in 1842 became judge of the supreme court of Nova Scotia, but subsequently gave up his profession, and went to live permanently in England. His first work was a 'Historical and Statistical Account of Nova Scotia' (1829). In 1835 he contributed a series of letters to a Halifax newspaper, under the pseudonym of "Sam Slick," clock-peddler. These were published with considerable alterations and additions, in a collected form in 1837, under the title of 'The Clockmaker, or Sayings and Doings of Samuel Slick of Slickville,' and became very popular. A second series followed in 1838, and a third in 1840. In 'The Attaché, or Sam Slick in England,' his hero is represented as attaché of the American embassy at the court of St. James, and again appears in 'Sam Slick's Traits of American Humor' (1852). Another work of his of some importance is 'Rule and Misrule of the English in America' (1851). In 1859 Haliburton was elected member of parliament for Launceston.

Hal'ibut, the largest of the flat fishes (*Hippoglossus vulgaris*), and one of the most important and highly prized food-fishes. It occurs in all Northern waters, south to France, New York and San Francisco. It reaches a weight of 400 pounds, and is characterized by having the eyes on the right side, the ventral fins and mouth symmetrical, and the lateral line arched in front. It is dark brown on the right side, and white on the left or lower side. It was formerly very abundant along the whole eastern coast of the United States, at times proving a nuisance from its numbers to the cod-fishers. It has gradually become scarcer, and at the same time the appreciation of it as a food-fish has increased, so that the halibut fishers have gone farther and farther for it until now a good proportion of the catch comes from the waters around Iceland. A second species, the Greenland halibut (*Reinhardtius hippoglossoides*) occurs in the Arctic Atlantic, but is not very common. It is yellowish brown and has a straight lateral line. In the trade this is not distinguished from the common species. Halibut are taken with hook and line (or trawls) using fresh fish (herring, etc.) for bait.

Hal'ifax, Charles Montague, Earl of, English politician: b. Horton, Northamptonshire, 16 April 1661; d. 19 May 1715. He first attracted notice by his verses on the death of Charles II.;

and in 1687, in conjunction with Matthew Prior, wrote 'The Town and Country Mouse,' a parody on Dryden's 'Hind and Panther.' He became a lord of the treasury in March 1692, in 1694 was made chancellor of the exchequer; in 1695 carried out the much needed re-coinage, appointing Newton warden of the mint; and in 1696 he devised the system of exchequer bills. His administration was distinguished by the adoption of the funding system, and by the establishment of the Bank of England. In 1700 he was raised to the peerage, under the title of Baron Halifax. In the reign of Anne he remained out of office, but he actively exerted himself to promote the union with Scotland, and the Hanoverian succession. George I. created him an earl, and bestowed on him the order of the Garter. The 'Life and Miscellaneous Works of Lord Halifax' were published in 1715, and his poems were included in the edition of 'English Poets' by Dr. Johnson.

Halifax, Canada, the capital of the province of Nova Scotia, and county-seat of Halifax County, a city and port of entry on Halifax Harbor, on the Intercolonial and Dominion, and Canadian Pacific R.R.'s. The harbor, originally known as Chebucto, "chief of havens," is one of the best in the world. It is 16 miles long from north to south, with an average width of a mile, and terminates in Bedford Basin, a beautiful sheet of water four miles wide, affording 10 square miles of safe anchorage. The North West Arm, an inlet on the west of the city, is a charming bay, on the shores of which are many of the villa residences of the wealthier Haligonians. The harbor is protected by 11 forts and batteries. A citadel crowns the hill, on the slopes and at the base of which the town is built. The streets are regularly laid out on a rectangular plan, are lighted by gas and electricity, and have electric street-car lines. The public buildings are built chiefly of freestone; the houses of wood. The most notable structures include Government House, the official residence of the lieutenant-governor, the armories, the post-office, the custom-house, the Province building, court-house, city-hall, Masonic Temple, Academy of Music, the Admiralty House, the Wellington barracks, several hospitals, and other charitable institutions, the Roman Catholic and Anglican cathedrals, and Saint Paul's church, the oldest Protestant church building in British North America. Among the higher educational institutions are the non-sectarian Dalhousie University and College (q.v.), the Roman Catholic College of Saint Mary, the Presbyterian Theological College, the Halifax Ladies' College and Conservatory of Music, and a high school. The city maintains a free library, an excellent waterworks system, and fine parks, including Point Pleasant Park, and the handsome public gardens covering 17 acres. Halifax is the chief British naval station in North America, and has extensive dockyards; besides Esquimalt it is the only military post in Canada garrisoned by British imperial troops; in 1901 the garrison amounted to 1,784 soldiers. Halifax has railroad communications with all parts of the Dominion and the United States, and steamship lines connecting with Great Britain, the West Indies, Boston, and New York. A United States consul-general is resident in Halifax. The chief occupations of the inhabitants are commerce and fisheries. The city has considerable West Indian trade, exporting lumber, fish, and agricultural products, and importing sugar, rum, molasses, and other sub-tropical products; most of the commerce of the province is carried on through Halifax. The principal manufactures are iron castings, machinery, agricultural implements, nails, paints, gunpowder, cordage, leather, boots and shoes, clothing, soap and candles, cotton and woolen goods, and woodenware; there are also sugar refineries, distilleries, and breweries.

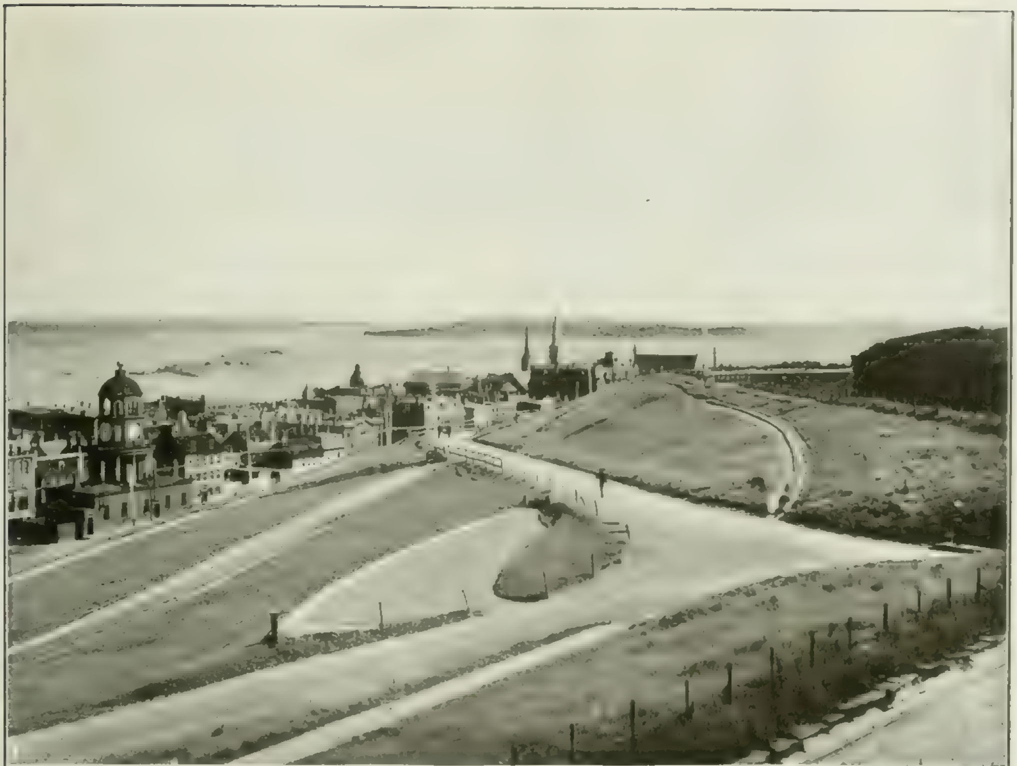
Halifax was founded in 1749 by the Hon. Edward Cornwallis, and named in honor of the Earl of Halifax. The following year it was made the capital of Nova Scotia, then including New Brunswick, in place of Annapolis; in 1817 it was declared a free port; in 1842 it was incorporated as a city. It is governed by a mayor, elected annually, and by 18 aldermen, elected triennially. The city and county send two members to the Canadian House of Commons, and three to the Provincial Legislature. Pop. (1901) 40,832.

John Forrest,
President Dalhousie College.

Halifax Commission, the designation for the commission of representatives of Great Britain and the United States which met at Halifax, Nova Scotia, in 1877, to determine the amount of compensation to be paid by the United States for the privileges which under the provisions of the fisheries treaty of 1871 between the two countries, had allowed the fishermen of the United States to take fish along the shores of Canada and Newfoundland. The great value of the British fishing waters was admitted and the sum of $5,500,000 was awarded Great Britain. The ten-year treaty which went into operation in 1873 was terminated by the U. S. government in 1885, and an attempt to renew it by the Chamberlain-Bayard Treaty in 1888 was frustrated by the rejection of the United States Senate. A *modus vivendi,* however, was arranged for, which the Dominion Parliament enacted as a law in 1890.

Hal'ite, the mineralogical name for native common salt, rock salt, or sodium chlorid, NaCl. Halite crystallizes in the isometric system, usually in cubes. It has a hardness of 2.5, and a specific gravity of 2.135 when pure, though it often occurs mixed with calcium sulphate, and with the chlorids of calcium and magnesium, the specific gravity being modified accordingly. Halite is usually colorless or white, though it is sometimes colored by impurities. Its refractive index for yellow sodium light is 1.5442, and transparent crystals of it are used somewhat in the manufacture of prisms and lenses, since the mineral is far more transparent than glass to the infra-red rays of the spectrum. Tyndall made extensive use of it in this way, for example, in his researches on radiant heat. (Consult his 'Contributions to Molecular Physics in the Domain of Radiant heat.') See Salt; Sodium.

Hall, Alexander Wilford, American editor and author: b. Bath, N. Y., 18 Aug. 1819. He became known as an evangelist, especially through attacks on Universalist doctrine and the theory of evolution as presented by Darwin, Huxley, and Haeckel. In 1881 he established



1. City of Halifax from the Citadel 2. North West Arm

ASAPH HALL,

PROFESSOR OF ASTRONOMY, HARVARD UNIVERSITY.

'The Microcosm,' and in 1893 became president of the Society for Philosophical Research. In 1891 he was elected fellow of the Philosophical Society of Great Britain. His works include: 'Universalism Against Itself'; 'The Problem of Human Life'; 'The Immortality of the Soul'; and 'The Hygienic Secret of Health.'

Hall, Anna Maria Fielding, British novelist: b. Dublin, Ireland, 6 Jan. 1800; d. East Moulsey, Surrey, England, 30 Jan. 1881. In her 15th year she went to London, where she was married to the well known writer, S. C. Hall (q.v.). She published 'Sketches of Irish Character' (1828); 'The Buccaneer' (1832); 'Tales of Woman's Trials' (1834); 'The Outlaw' (1835); 'The French Refugee,' a drama; 'Uncle Horace' (1837); 'Lights and Shadows of Irish Character' (1838); 'Marian' (1839); 'Midsummer Eve' (1843); 'The Whiteboy' (1845); etc. Her 'Stories of the Irish Peasantry' appeared originally in 'Chambers's Journal.' Besides assisting her husband in writing 'Ireland: its Scenery, etc.' (1841-3) and other works, she assisted in the establishment of a hospital for consumptives, and the Nightingale Fund, which resulted in the endowment of a training-school for nurses.

Hall, Arthur Crawshay Alliston, American Protestant Episcopal bishop: b. Benfield, Berkshire, England, 12 April 1847. He was graduated from Christ Church, Oxford, in 1869, took orders, entered the Society of St. John the Evangelist (Cowley Fathers), in 1874 became assistant minister of the Church of the Advent, Boston, and from 1882 to 1891 was there minister of the mission church of St. John the Evangelist. In 1894 he was consecrated bishop of Vermont, after release from the Cowley order. His publications include: 'Confession and the Lambeth Conference' (1879); 'Meditations on the Creed' (1880); 'Meditations on the Collects' (1887); and other doctrinal and devotional works.

Hall, Asaph, American astronomer: b. Goshen, Litchfield County, Conn., 15 Oct. 1829. He learned the carpenter trade but after private study attended Central College, McGrawville, N. Y., in 1854-5, was for a term a pupil of Francis Brünnow at the University of Michigan, taught at Shalersville, Ohio, and later was appointed assistant to Bond in the Harvard observatory. He became assistant in the Naval Observatory at Washington in 1862, and in 1863 professor of mathematics in the navy, with relative rank of captain. He continued in the government service until 1891, when he was retired on account of age, with relative rank of captain. While at the Naval Observatory, he was despatched on several expeditions, including those for observation of solar eclipses to Bering Strait in 1869, to Sicily in 1870, and to Colorado in 1878. He was also in charge of the American party sent to observe the transit of Venus at Vladivostock, Siberia, in 1874, and chief astronomer of the expedition to San Antonio, Tex., for the transit of 1882. Among his many discoveries the most important is that of the moons of Mars (August 1877), which he named Deimos and Phobos, and whose orbits he calculated. Among his later work is a valuable study of double stars. In 1895-1901 he was professor of astronomy at Harvard. He received the Lalande prize of the French Academy of Sciences in 1878, its Arago medal in 1895, and the gold medal of the Royal Astronomical Society in 1879. In 1902 he was president of the American Association for the Advancement of Science.

Hall, Basil, British naval officer and writer: b. Edinburgh 31 Dec. 1788; d. Portsmouth, England, 11 Sept. 1844. He entered the navy in 1802, accompanied Lord Amherst's expedition to China in 1815, a trip which supplied him with the materials of his first work, 'A Voyage of Discovery to the West Coast of Corea, and the great Loo Choo Island in the Japan Sea.' This work, first published in 1818, had a very extensive circulation. In 1827 he made a tour in Canada and the United States, and published his 'Travels in North America' (1829), a work which excited much adverse criticism in the United States by reason of its outspoken and somewhat supercilious comments and observations. 'Fragments of Voyages and Travels' appeared in 1831-33, and was followed by 'Schloss Hainfield, or a Winter in Styria' and 'Patchwork' (1841).

Hall, Bolton, American lawyer and lecturer: b. Ireland 1854. A son of John Hall (q.v.), he was graduated from Princeton in 1875, became known as a writer and lecturer in connection with various reforms, and has been identified with the University extension movement. Among the causes advocated by him are the cultivation of vacant lots by the unemployed, and the restoration of the land to the people. His publications include: 'Even as You and I.'

Hall, Charles Cuthbert, American Presbyterian clergyman: b. New York 3 Sept. 1852. He was graduated from Williams College in 1872, studied theology at the Union Theological Seminary 1872-3, and at the Presbyterian College in London and the Free Church College, Edinburgh. He was pastor of the Presbyterian Church, Newburg, N. Y., 1875-7, and of the 1st Presbyterian Church, Brooklyn, N. Y., 1877-97. In the year last named he was elected president of Union Theological Seminary. He has published 'Into His Marvellous Light: Studies in Life and Belief' (1891); 'Does God Send Trouble?' (1894); 'The Children, the Church and the Communion' (1895); 'The Gospel of the Divine Sacrifice' (1896).

Hall, Charles Francis, American Arctic explorer: b. Rochester, N. Y., in 1821; d. Thank God Harbor, Greenland, 8 Nov. 1871. Becoming interested in the fate of the Franklin expedition, he devoted his leisure to gathering information about Arctic America, and made two search expeditions, in 1860-2 and 1864-9, living alone among the Eskimo, and bringing back relics of the Franklin expedition and the supposed bones of one of Franklin's company. Natives whom he encountered in 1869 near the southern shore of King William Land gave him a report of the fate of 79 of the 105 who perished by starvation in that region. He thus contributed much to the details of the expedition's final history. In 1871 he sailed in command of the government ship 'Polaris,' on an expedition to the North Pole. On 29 August he reached 82° 11′ N., at that date the highest north latitude ever reached. Then turning south he went into winter quarters at Thank God Harbor, Greenland (81° 38′ N.). Here he was taken suddenly ill, and died. Over his grave a grateful epitaph was placed by the British polar expedition in 1876. His compan-

ions left Thank God Harbor in August, 1872, but in October, through the ice-anchor slipping, 19 men were left with stores on a floe, and only after five months of severe sufferings were they rescued by a sealer off the Labrador coast in the following April. The 'Polaris' drifted to the coast of Greenland, at a point not far south of Smith Sound, and thence in the spring the party set out in boats and was rescued by the Scotch whaler 'Ravenscraig,' off Cape York. Among the valuable results of Hall's work were the exploration of Kennedy channel, the discovery of Robeson Channel and Hall Basin, and the extension of Greenland and Grinnell Land 1½° N. Hall was less a scientist than a fearless and resourceful explorer. He published 'Arctic Researches, and Life among the Esquimaux' (1864); and mainly from his papers was compiled the 'Narrative of the Second Arctic Expedition' (1879).

Hall, Charles Winslow, American lawyer and author: b. Chelsea, Mass., 2 Nov. 1843. He was admitted to the Suffolk bar in 1866 and besides editing various New England journals has written: 'Arctic Rovings' (1861); 'Twice Taken' (1867); 'Adrift in the Icefields' (1877); 'Drifting Round the World' (1881); 'Legends of the Gulf'; 'Cartegena, or the Last Brigade'; 'Regiments and Armories of Massachusetts.'

Hall, Chester Moor, English inventor: b. Leigh, Essex, England, 9 Dec. 1703; d. Sutton, Essex, 17 March 1771. He was a large landowner in Essex, and convinced from study of the human eye that achromatic lenses were possible, he discovered two varieties of suitable glass in 1729, and in 1733 made several telescopes later declared by experts to be achromatic. Indifferent to his claims of priority, he did not appear at the trial of Dollond *v.* Champness. Later his invention of the achromatic telescope in the year 1733 was adjudged by Lord Mansfield conclusively proven.

Hall, Christopher Newman, English Congregational clergyman: b. Maidstone, England, 22 May 1816; d. London 18 Feb. 1902. He was educated at Highbury College and ordained in 1842, his first charge being at Hull. In 1854 he was made pastor of Surrey Chapel, Blackfriar's Road, London, from which place he moved with his congregation into Christ Church, Westminster Bridge Road, erected mainly through his exertions, and of which he became pastor emeritus in 1893. During the Civil War he did much by tongue and pen to give his countrymen correct ideas of the nature of the struggle in the United States. In 1865 he visited this country and again in 1873 when he delivered lectures in the principal cities. He was the author of 'The Christian Philosopher'; 'Land of the Forum and the Vatican'; 'Lectures in America'; and of a famous tract 'Come to Jesus' (1840) of which millions of copies have been issued, etc.

Hall, Edward Henry, American Unitarian clergyman and author: b. Cincinnati, Ohio, 16 April 1831. He was graduated from Harvard in 1851, ordained to the Unitarian ministry in 1859, and was pastor at Plymouth, Mass., 1859–67; Worcester, Mass., 1869–82; and at Cambridge, Mass., 1882–93. His writings include, besides a volume of 'Discourses'; 'Orthodoxy and Heresy in the Christian Church'; 'Lessons on the Life of St. Paul'; 'Papias and his Contemporaries: a Study of Religious Thought in the 2d Century' (1899).

Hall, Fitzedward, American philologist: b. Troy, N. Y., 21 March 1825; d. Marlesford, England, 1 Feb. 1901. He was graduated from Harvard in 1846; spent many years in India; made a thorough study of its tongues, and contributed to its local journals original translations and original articles. In 1850 he became tutor, in 1853 professor, in the government college at Benares; in 1855 was transferred to Ajmere as inspector of schools for Ajmere and Maiwara; and in 1856 to a like post in the Central provinces. In 1862–79 he was professor of Sanskrit, Hindustani, and Indian jurisprudence in King's College, London; in 1864 became examiner in Hindustani and Hindu to the civil-service commission; in 1880 examiner in Sanskrit to succeed Max Müller; and in 1887 also examiner in English. He was the first American to edit a Sanskrit text—'The Atmabodha, with its Commentary, and the Tattvabodha' (1852). He prepared also an edition of the 'Vishnupurâna,' containing numerous quotations from manuscripts owned by him; and editions of many other Sanskrit books. His collection of 1,000 Oriental manuscripts and 1,000 works on special subjects, he gave to Harvard. He wrote further: 'Modern English' (1873), 'Doctor Indoctus' (1880), and other works on English philology, and contributed to the 'New Oxford Dictionary.'

Hall, Florence Marion Howe, American author and lecturer: b. Boston 25 Aug. 1845. She is a daughter of Julia Ward Howe (q.v.). Prominent in the women's club movement, she became vice-president of the General Federation of Women's Clubs, and chairman of the educational department of the New Jersey State federation of women's clubs. In 1893–1900 she was president of the New Jersey Women's Suffrage Association. Her writings are: 'Social Customs' (1887); 'The Correct Thing' (1888).

Hall, Francis J., American Episcopal theologian: b. 24 Jan. 1856. He was graduated from Racine College, Wis., and the General Theological Seminary, New York, and has been professor of dogmatic theology in the Western Theological Seminary from 1886. He has published 'Theological Outlines' (1892–5); 'Historical Position of the Episcopal Church' (1896); 'The Kenotic Theory' (1898).

Hall, George Henry, American artist: b. Boston 1825. He studied art at Düsseldorf, Paris, and Rome; established his studio in New York; and became known as a still-life and figure painter. In 1868 he was elected a national academician. Among his works are 'April Showers'; 'Studies of Grapes'; 'The Seasons'; and 'Bric-a-Brac of Damascus'.

Hall, Gertrude, American writer: b. Boston 8 Sept. 1863. She has written 'Far from To-day,' a collection of short stories; 'Allegretto,' a book of verse; 'Foam on the Sea, and Other Tales'; 'The Hundred and Other Stories' (1898); 'The Age of Fairy Gold,' verse (1899); 'April's Sowing' (1900). Her work, both in verse and prose, is distinctively original.

Hall, Gordon, American missionary at Bombay: b. Tolland, Mass., 8 April 1784; d. Bombay 20 March 1826. He was graduated at

Williams College in 1808 and having studied theology, offered himself as a missionary to the American board of commissioners for foreign missions. Ordained at Salem in February 1812, he sailed the same month for Calcutta and arriving at Bombay in 1813, spent 13 years in missionary labors. No missionary in western India has been more respected among the Brahmins and higher classes than he. Beside publishing several missionary tracts he revised the Mahratta New Testament.

Hall, Granville Stanley, American psychologist and college president: b. Ashfield, Mass., 6 May 1845. He was graduated from Williams College in 1867, studied also at Berlin, Bonn, Heidelberg, and Leipsic, was professor of psychology in Antioch College (Ohio) in 1872–6, and lecturer on psychology at Harvard and Williams in 1880–1. From 1881 to 1888 he was professor of psychology in the Johns Hopkins University; and in 1888 became president of Clark University, then newly founded at Worcester, Mass., and professor of psychology in the institution. He soon became known as an authority on education and a leader in the «new psychology.» As editor of the 'Pædagogical Seminary' and the 'American Journal of Psychology,' he published: 'Aspects of German Culture' (1881); 'Hints toward a Select and Descriptive Bibliography of Education' with Mansfield (1886); 'Methods of Teaching History'; 'How to Teach Reading'; etc.

Hall, Isaac Hollister, American Oriental scholar: b. Norwalk, Conn., 12 Dec. 1837; d. Mount Vernon, N. Y., 2 July 1896. Graduated from Hamilton College in 1859, he was there tutor until 1863, in 1865 was graduated from the Columbia Law School, and until 1875 was a practitioner in New York. In 1875–7 he was professor in the Syrian Protestant College at Beirut, and later at Cyprus aided Gen. di Cesnola, then United States consul, in the arrangement of the Cypriote collection now in the Metropolitan Museum of New York. From 1884 until his death he was curator of sculpture and archæology in the Metropolitan Museum. He also lectured on New Testament Greek at the Johns Hopkins University; published (1884) an account, with facsimile pages, of the Syrian manuscripts of the Gospels, Acts, and the larger part of the Epistles, discovered by him (1876) at Beirut; and compiled a 'Critical Bibliography of the Greek New Testament' (1884).

Hall, Sir James, English geologist and chemist: b. 1761; d. Edinburgh 23 June 1832. Early interested in geological questions, he made the acquaintance of James Hutton (q.v.) and Playfair, and himself states that he came to adopt Hutton's system after three years of almost daily discussion with its founder. In the examination of this system, whose leading principle explains the conformation of the earth's crust by the action of constant natural changes, he traveled in Scotland, the Alps, Italy, and Sicily. Hall was the first geologist directly to apply chemical laboratory tests to the hypotheses of geology, but published no results of his work in this field until after the death (1797) of Hutton who objected to the judgment of the vast operations of nature through «having kindled a fire and looked into the bottom of a little crucible.» He was elected president of the Royal Society of Edinburgh, invented a machine for the regulation of high temperatures, and in 1807–12 represented Michael (or Mitchell), Cornwall, in Parliament. He wrote various scientific memoirs.

Hall, James, American lawyer and author: b. Philadelphia 19 Aug. 1793; d. near Cincinnati, Ohio, 5 July 1868. He served in the army 1812–18, and subsequently studying law became judge of the circuit court of Illinois, and also State treasurer. In 1833 he took up his residence in Cincinnati, and devoted himself to banking and literature. His chief works are: 'Legends of the West'; 'Harpe's Head, a Legend of Kentucky' (1833); 'Sketches of the West' (1835); 'Tales of the Border' (1835); 'Notes on the Western States' (1838); 'History of the Indian Tribes' (1838–44) with McKenney; 'The Wilderness and the War-Path' (1845); 'Romance of Western History' (1859).

Hall, James, American geologist and palæontologist: b. Hingham, Mass., 12 Sept. 1811; d. near Bethlehem, N. H., 7 Aug. 1898. He studied at the Rensselaer Polytechnic School for six years, and was subsequently professor of geology there, and in 1837 was appointed to a position on the New York Geological Survey. In 1855 he was appointed State geologist of Iowa. In 1850 he was elected by the Royal Geographical Society of London one of its 50 foreign members, and in 1858 received the Wollaston Medal from that scientific body. He was a distinguished member of many scientific societies at home and abroad and was held in the highest esteem for his attainments in geology and palæontology. Among his publications may be named 'Geology of New York' (1843); 'Palæontology of New York' (1847 *et seq.*); 'Graptolites of the Quebec Group' (1865); as well as parts of the Geological Reports of Iowa (1858–9); and Wisconsin (1862).

Hall, John, American Presbyterian clergyman: b. near Armagh, Ireland, 31 July 1829; d. Bangor, County Down, Ireland, 17 Sept. 1898. He was educated at Belfast College and after holding several pastorates in Ireland, in 1867 became pastor of the Fifth Avenue Presbyterian Church, New York. He was chancellor of the University of the City of New York 1882–90, and was also trustee of Princeton University, Union Theological Seminary, and of Wellesley College. He was noted for his simple eloquence and impressive sincerity and was one of the most prominent clergymen in his denomination. He wrote 'Family Prayers for Four Weeks' (1868); 'Papers for Home Reading' (1871); 'Questions of the Day' (1873); 'God's Word through Preaching' (1875); 'Foundation-Stones for Young Builders' (1879); 'A Christian Home: how to Make and how to Maintain It' (1883).

Hall, John M., American railroad president: b. Willimantic, Conn., 16 Oct. 1841; d. New Haven, Conn., 27 Jan. 1905. He was graduated from Yale in 1866 and from the Columbia Law School in 1868. He took up the practice of law in his native town and became a judge of the superior court in 1889, resigning in 1893 to become vice-president of the New York, New Haven and Hartford Railroad Company. On the death of President Clark in 1899, Judge Hall succeeded him as president.

Hall, Joseph, English prelate: b. near Ashby-de-la-Zouch, Leicestershire, 1 July 1574; d. near Norwich 8 Sept. 1656. While yet in college he published his 'Virgidemiarum,' a series of poetical satires, remarkable for elegant and energetic versification, strong and lively coloring, and masterly traces of genuine humor. Having taken orders he obtained the rectory of Halsted, near St. Edmund's Bury, where he published a very popular work, 'A Century of Meditations.' In 1617 he became dean of Worcester, and was raised to the see of Exeter in 1627. After the open rupture between the king and Parliament, he came forward in defense of the liturgy and discipline of the church, against the views which the leading Nonconformists had published, in a treatise called, after the initials of the names of its authors, 'Smectymnuus' (q.v.). In the end of 1641 Bishop Hall was translated from the see of Exeter to that of Norwich, but was later imprisoned in the Tower with the other prelates who had protested against their expulsion from the House of Peers. In 1643 he was specially named in the ordinance passed for sequestering what were called "notorious delinquents." His prose works edited by Philip Wynter were published in 1863. Among the latter, the best known and most popular is his 'Contemplations,' which still finds many readers.

Hall, Lyman, American patriot: b. Wallingford, Conn., 12 April 1724; d. Burke County, Ga., 19 Oct. 1790. He was graduated from Yale in 1747, studied medicine, and began practice in Wallingford, Conn., but finally settled near Sunbury, Ga., where he became a leading physician. The settlers in this locality were from New England, and on the outbreak of trouble with England, they with Hall as leader took active part in the rebellion, though Georgia was slow in joining the patriot cause. Hall was sent by them as a representative to the Continental Congress, where he was admitted by a unanimous vote, and took part in all debates, but did not vote when the vote was taken by colonies, until Georgia was represented as a colony. In 1776 it was so represented, and Hall continued a member of the Congress till 1780, being one of those who signed the Declaration of Independence. He was elected governor of Georgia in 1783, and in an energetic administration of one year, he did much to repair the damage done by the war, established land offices and schools, and then retired from public life. Consult: Dwight, 'Signers of the Declaration' and an article, 'Lyman Hall' in the 'Magazine of American History,' XXV. 35.

Hall, Marshall, English physician and physiologist: b. Basford, near Nottingham, 18 Feb. 1790; d. Brighton, England, 11 Aug. 1857. In 1809 he commenced the study of medicine at the University of Edinburgh, and took his degree in 1812. In 1817 he commenced practice at Nottingham, and soon rose to eminence. In 1826 he settled in London, where he carried on a most successful practice. He paid especial attention to the symptoms of illness and in 1817 published 'Diagnoses of Diseases,' and in 1824 his 'Medical Essays' appeared. His 'Essay on the Circulation of the Blood' (1831) contained an account of his discovery of the so-called "caudal heart" in the tail of the eel. The more important of his other writings are: 'Lectures on the Nervous System and its Diseases' (1836), 'Theory and Practice of Medicine' (1837); 'Theory of Convulsive Diseases' (1848). His services to the cause of humanity were numerous and valuable, and among these one of the most widely known is the method which he invented of restoring suspended respiration, now generally adopted in the case of persons partially drowned. It is known as the "Marshall Hall Method." See DROWNING.

Hall, Robert, English Baptist clergyman: b. Arnsby, Leicestershire, England, 2 May 1764; d. Bristol, England, 21 Feb. 1831. He studied at the Baptist College at Bristol and King's College, Aberdeen, and entered the Baptist ministry, becoming in a few years not only the most prominent minister in his denomination but one of the very foremost of English orators. He was also widely known as a master of prose style, his most noted writings being 'Apology for the Freedom of the Press' (1793); 'Modern Infidelity' (1800); 'Reflections on War' (1802). He was subject to attacks of insanity but in spite of this misfortune accomplished a vast amount of intellectual work and was a tireless student. His complete works in six volumes reached an 11th edition in 1853.

Hall, Robert Henry, American soldier: b. Detroit, Mich., 15 Nov. 1837. He was educated at West Point and served in the Federal army during the Civil War, and was in command of a brigade during the war in the Philippines. He became a brigadier-general in the United States army in 1901. He has published 'Register of the United States Army 1789–98'; 'History of the Flag of the United States'; 'History of United States Infantry Tactics.'

Hall, Ruth, American novelist: b. Schoharie, N. Y., 10 April 1858. Besides more or less journalistic work she has written: 'In the Brave Days of Old' (1898); 'The Boys of Scrooby' (1899); 'The Black Gown,' a novel of colonial Albany (1900); 'The Downrenter's Son,' a novel of the anti-rent troubles in New York State (1902); 'The Golden Arrow' (1903).

Hall, Samuel Carter, English miscellaneous writer: b. Topsham, Devonshire, England, 1801; d. 16 March 1889. For over 40 years he was the editor of the 'Art Journal,' which he founded in 1839. With his wife (Anna Maria) (q.v.) he published: 'Ireland, its Scenery and Character' (1841–3); 'Book of Royalty' (1838); 'A Woman's Story' (1857); 'The Book of the Thames' (1859); 'A Companion to Killarney' (1878); and others. His separate works were: 'A Book of Memories'; 'Book of British Ballads'; 'Baronial Halls'; 'Retrospect of a Long Life' (1883).

Hall, Thomas, American inventor: b. Philadelphia 4 Feb. 1834. He was educated at the University of Pennsylvania, and subsequently studied mechanics in Europe, and at the Paris exposition in 1867 placed a keyed typewriter on exhibition. His numerous inventions include a mechanism for printing by touching keys; a keyed typewriter, the Hall typewriter, first offered for sale in 1881; several sewing-machines, as well as drill-grinding and other machinist tools, etc.

Hall, Thomas Cuming, American theologian: b. Armagh, Ireland, 25 Sept. 1858. He was graduated from Princeton in 1879, from the Union Theological Seminary in 1882, studied also in Berlin and Göttingen, and was a pastor in

Omaha and Chicago. In 1898 he became professor of theology in the Union Seminary. Among his works are: 'The Power of an Endless Life' (1893); 'The Social Significance of the Evangelical Revival in England' (1899); and 'The Synoptic Gospels' (1900).

Hall, a large room or apartment, the term having its origin in the castles and mansions of the Middle Ages. Here the king or the lord of the manor gave audience, administered justice, and received and entertained his retainers and guests. At one end of the hall was a raised platform or dais, on which the table of the lord of the manor and his honored guests was placed. This end of the hall was usually lighted with large oriel windows, and communicated with a building which contained the lords' solar, or bedroom and parlor, on the upper floor, and the wine cellar below. The retainers sat at a table which ran along the lower part of the hall. The entrance was at the lower end of the hall, where a passage gave access to the kitchen, pantry, and buttery. Above the passage a gallery for musicians was frequently constructed. Survivals of such mediæval dining halls may be found in the Oxford and Cambridge colleges; also in the halls of the Inns of Court and of some of the London guilds. The hall partook of the style of architecture prevailing at the time when it was built, and being a large and important apartment was generally ornamental in its character. The hall of the king's palace, now known as Westminster Hall, built by William Rufus and restored by Richard II., is the finest example in England, being 300 feet long and 100 feet broad. In the United States Nassau Hall, Princeton; Carnegie Hall, New York; Faneuil Hall, Boston; Independence Hall, Philadelphia, are examples of the modern hall.

Hall-marks. See PLATE-MARKS.

Hall of Fame, a memorial to famous Americans, at the New York University. The institution received a gift of $100,000 with which it built a colonnade 500 feet long on University Heights, a beautiful site in upper New York, overlooking the valleys of the Harlem and the Hudson. Large panels to the number of 150, two feet by eight, will bear simple inscriptions of the names and dates of birth and death of the famous native Americans who are chosen as the 150 greatest men. Of these, 50 were chosen in 1903, and five every five years thereafter till the year 2000. The public was invited to make nominations; and such nominations as were seconded by the Senate of the University were submitted to 100 judges, representing every State in the Union. These judges were university and college presidents, professors of history, scientists, publicists, editors, authors, and judges of the supreme court, national and state. Ninety-seven of these sent in their votes, and 29 great men, native and 10 years dead, chosen by this vote, and thereafter ratified by the Senate of the University, are the first of these immortals.

Naturally George Washington headed the list, with Abraham Lincoln second, and Daniel Webster came third. The names of Bryant, Poe, and Cooper are likely to be added hereafter. Lowell was not dead 10 years and was not yet eligible. Bryant failed by three votes, Greeley by five, Motley by nine. The most animated discussion was provoked by the selection of General Robert E. Lee. But since only a minority of the judges were Southern men, the vote for him was at least not sectional. The names of 21 other great men will be added to the list. The following shows the roll of names chosen for the Hall of Fame, and the number of votes that each received:

George Washington	97
Abraham Lincoln	96
Daniel Webster	96
Benjamin Franklin	94
Ulysses S. Grant	92
John Marshall	91
Thomas Jefferson	90
Ralph Waldo Emerson	87
Henry Wadsworth Longfellow	85
Robert Fulton	85
Washington Irving	83
Jonathan Edwards	81
Samuel F. B. Morse	80
David Glasgow Farragut	79
Henry Clay	74
Nathaniel Hawthorne	73
George Peabody	72
Robert E. Lee	69
Peter Cooper	69
Eli Whitney	67
John James Audubon	67
Horace Mann	67
Henry Ward Beecher	66
James Kent	65
Joseph Story	64
John Adams	61
William Ellery Channing	58
Gilbert Stuart	52
Asa Gray	51

Hall of Odin, a tradition among the Scandinavian peoples, which tells of the rocks from which the Berserkers, when tired of life, flung themselves into the sea; so named because they were regarded as the portals of the Scandinavian Valhalla.

Hallam, hăl'am, **Arthur Henry,** English essayist: b. London 1 Feb. 1811; d. Vienna 15 Sept. 1833. He was a son of Henry Hallam (q.v.), and was graduated in 1832 from Trinity College, Cambridge, entered the Inner Temple and later the office of a conveyancer of Lincoln's Inn; and died during a visit to the Continent. At Cambridge he met Alfred Tennyson, whose 'In Memoriam,' through which he is best known, employs his sudden and untimely death as a basis for the exposition of a poet's philosophy. His 'Remains in Prose and Verse' (1834), largely justify the high hopes entertained for him, especially in the critique of Rossetti's 'Disquisizione sullo spirito antipapale,' and the essay on Cicero.

Hallam, Henry, English historian: b. Windsor 9 July 1777; d. Penshurst, Kent, 21 Jan. 1859. He was educated at Oxford, and in 1818 made his appearance as an author by his 'View of the State of Europe during the Middle Ages,' which at once established his reputation, and is acknowledged as a standard work. His next work, the 'Constitutional History of England' (1827), is justly regarded as a model at once of laborious research and scrupulous impartiality — an impartiality so scrupulous, that his readers are sometimes perplexed to discover to which side his judgment inclines. His 'Introduction to the Literature of Europe' (1837–9), if it could not add to his reputation, certainly did not detract from it. His eldest son, Arthur Henry (q.v.), died in early manhood; the great hopes buried with him may be gathered from a most affecting 'Memoir' printed by his father for private circulation, while Tennyson's

‹In Memoriam,› of which Arthur Hallam is the subject, has raised to him a durable monument.

Hallé, häl-lā, Sir **Charles**, Anglo-German pianist: b. Hagen, Westphalia, 11 April 1819; d. Manchester, England, 25 Oct. 1895. He studied first at Darmstadt, and afterward at Paris, where his reputation was established by his concerts of classical music. But the revolution of 1848 sent him to England, and he made his home in Manchester. There he established in 1857 a series of subscription orchestral concerts which did much to raise the popular standard of musical taste by familiarizing the British public with the great masters of classical music. The orchestra which he conducted some forty years was the most finely trained body of musicians in the United Kingdom. He was knighted in 1888, and married the same year the famous violinist, Madame Norman-Neruda.

Hallé, Wilma Maria Francesca Neruda, Lady, Austrian violinist: b. Brunn, Moravia, 1840. She made her debut at Vienna in 1846, exciting the greatest enthusiasm by her wonderful execution. Her first husband was a Swedish musician, Ludwig Norman, and as Madame Norman-Neruda she was famous in England and America long before her marriage to Sir Charles Hallé (q.v.) in 1888. After the death of the latter she visited the United States on a concert tour.

Halle, häl'lė, or **Halle an der Saale,** än-dĕr-zä'lė, Germany, a town and important railway junction of six lines, in Prussian Saxony, about 20 miles northwest of Leipsic, on the river Saale. It consists of the mediæval town with narrow, crooked streets and ancient dwellings, separated by boulevards on the site of the old ramparts, from extensive and handsome suburbs. Among notable public buildings are the restored mediæval Rathaus; the «Red Tower» in the market place, a 15th century clock-tower; the decaying Moritzburg, formerly a citadel and archiepiscopal residence; the modern Gothic Ratskeller; the extensive buildings of the University (q.v.); a deaf and dumb asylum; a lunatic asylum; the 12th century Moritzkirche with fine wood carvings; the 16th century Protestant cathedral; and the 16th century Gothic church of the Virgin, with four towers and noted for its handsome interior. In the suburb of Glaucha the Waisenhaus, «orphan house,» or institution founded by the Rev. Francke about 1693 forms a small town in itself. Besides the orphan asylum it includes different grade schools, attended by between 3,000 and 4,000 pupils; a printing and publishing establishment; and a laboratory where medicines are prepared and sold. The trade and manufactures of Halle are extensive. The latter include starch, beet-root sugar, chemicals, oil, machinery, etc., besides the celebrated ancient salt works.. The salt workers form a distinctive colony with special exemptions and privileges and are known as «Halloren.» Halle is mentioned as Halla as early as 806; in the 12th century it had developed considerable trade, and in the next two centuries was an important member of the Hanseatic League. In 1806 it was taken by the French; in 1813 it was annexed to Prussia. Pop. (1900) 156,661.

Halle, University of, Germany, a celebrated institution founded in 1694 by King Frederick I. in the interests of the jurist Thomasius, when he was followed to Halle by several students after his retirement from Leipsic owing to the envy of his fellow professors. It attained a high degree of prosperity, but owing to its strong Prussian proclivities was suppressed by Napoleon in 1806 and in 1813. It was re-established in 1815 and in 1817 was united with the University of Wittenberg. Its buildings which are very extensive, especially those accommodating the medical faculty, date from 1832. There are faculties of theology, law, medicine, and philosophy. From its foundation Halle was recognized as one of the principal schools of Protestant theology, and has numbered among its professors some of the most eminent names of Germany. Connected with the university is an ever-increasing library of over 220,000 volumes and MSS., a medical and surgical clinical institute; a maternity hospital; an observatory; a theological and normal seminary; and a botanical garden; especial attention is devoted to agriculture. In 1903 the university had nearly 2,000 students.

Halleck, hăl'ĕk, **Fitz-Greene,** American poet: b. Guilford, Conn., 8 July 1790; d. there 19 Nov. 1867. At 18 he became a clerk in a New York bank, in which employment he remained for 20 years. For a long period after this he was the confidential agent of John Jacob Astor, and was named by him one of the original trustees of the Astor Library. In 1849 he retired to his native town. He wrote verses in his boyhood, but these early effusions were excluded from the collected editions of his poems. In 1819 he assisted Joseph Rodman Drake (q.v.) in the humorous series of ‹Croaker› papers, contributed to the New York *Evening Post.* Drake's death in the succeeding year was commemorated by Halleck in a most touching poem. In 1819 was published Halleck's longest poem, ‹Fanny,› a satire, in the measure of Byron's ‹Don Juan,› on the fashions, follies, and public characters of the day. From the variety and pungency of the local and personal allusions it enjoyed a great but fleeting popularity. In 1827 he published an edition of his poems in one volume, two of the best in the collection, ‹Alnwick Castle› and ‹Burns,› having been suggested by scenes and incidents of foreign travel. This edition also included the spirited lyric, ‹Marco Bozzaris,› by which he will probably be longest kept in mind. Consult Wilson, ‹Life and Letters of Fitz-Greene Halleck› (1869).

Halleck, Henry Wager, American soldier: b. Westernville, N. Y., 16 Jan. 1815; d. Louisville, Ky., 9 Jan. 1872. He was graduated at the United States Military Academy in 1839, was assistant to the Board of Engineers at Washington 1840–1, and in 1841–6 assistant engineer in the repair of the New York harbor fortifications. In the Mexican War he was on the Pacific coast, and in 1847–9 was secretary of State for California under the military government. After service as inspector and engineer of lighthouses (1852–4) and as engineer of the board for fortifications on the Pacific coast (1853–4), he resigned from the service in 1854, and practised law in San Francisco. On the outbreak of the Civil War he re-entered the army, and in November 1861, was appointed commander of the department of the Missouri,

then in a state of thorough disorganization. He quickly reduced the department to order, outlined the western campaign of 1862, directed this campaign in person from 11 April, and took Corinth, with its 15 miles of entrenchments, on 30 May. In July he became general-in-chief of the armies of the United States; and henceforth directed from Washington the movements of the generals in the field, till, in March 1864, he was superseded by Gen. Grant. Halleck was chief of staff till 1865, commanded the military division of the James in 1865, that of the Pacific, 1865–9, and that of the South from 1869 until his death. He wrote a work on 'The Elements of Military Art and Science' (1846), largely used as a manual in the Civil War; 'Bitumen' (1841); 'A Collection of Mining Laws of Spain and Mexico' (1859), and other volumes.

Halleck, Reuben Post, American educator: b. Rocky Point, L. I., 8 Feb. 1859. He was graduated from Yale in 1881, was instructor in the Male High School, Louisville, Ky., 1883–96, and principal from the latter date. He has published: 'Psychology and Psychic Culture' (1895); 'The Education of the Central Nervous System' (1890); 'History of English Literature' (1900).

Hallelujah, hăl-e-loo'ya, **Halleluia,** or **Alleluia** (Hebrew), «Praise ye the Lord»; an expression which occurs often in the Psalms, and which was retained when the Bible was translated into the various languages, probably on account of its full and fine sound, which, together with its simple and solemn meaning, so proper for public religious services, has rendered it a favorite of musical composers. The Roman Catholic Church does not allow it to be sung on the Sundays during Lent, on account of the mournful solemnity of the season; and in that church it is not sung again before Easter. It is no longer sung in masses for the dead as formerly. In the time of Augustine the African Church used this doxology only from Easter to the feast of Pentecost. The Greeks made an earlier or more common use of the Hallelujah than the Latin Church. The Jews call the Psalms cxiii.-cxvii. the Great Hallelujah, because they celebrate the particular mercies of God toward the Jews, and they are sung on the feast of the Passover, and on the feast of Tabernacles.

Haller, Albrecht von, ăl'brĕHt fōn häl'lĕr, Swiss anatomist, botanist and poet: b. Bern 16 Oct. 1708; d. there 12 Dec. 1777. Having chosen the medical profession, he went to the University of Tübingen, where he studied comparative anatomy under Duvernoy; and in 1725 removed to Leyden, then the first medical school in Europe. After extensive travels in England and France he went to Basel in 1828 to study mathematics under Bernoulli. Here he first imbibed a taste for botany, and composed his poem 'Die Alpen', followed by various ethical epistles and other pieces, which gave him a reputation in Germany. In 1729 he returned to his native city, and entered on his professional career as a public lecturer on anatomy. In 1736 he became professor of anatomy, surgery, and botany, in the newly founded University of Göttingen, and through his influence the university was enriched with a botanical garden, an anatomical theatre, a school for midwifery, and a college of surgery. In 1747 appeared the first edition of his 'Primæ Lineæ Physiologiæ,' which, long after the death of the author, was used as a text-book in schools of medicine. In 1752 he first advanced his opinions on the properties of sensibility and irritability as existing in the nervous and muscular fibres of animal bodies; doctrines which attracted much attention, and excited great controversies in the medical world. Disagreements with his colleagues induced him to return, in 1753, to Bern, where his countrymen received him with the respect due to his fame and talents. Having been elected a member of the sovereign council of the state, he soon obtained by lot one of its magistracies, and entered with zeal on the duties of a citizen, though he did not neglect his scientific pursuits. He was elected in 1754 one of the foreign associates of the Paris Academy of Sciences. In 1758 he became director of the public salt-works at Bex and Aigle, and in the course of his superintendence introduced many improvements in the manufacture of salt. His later published works include: 'Elementa Physiologiæ Corporis Humani' (1757–66); 'Bibliotheca Botanica' (1771); 'Bibliotheca Anatomica' (1774); 'Bibliotheca Chirurgica' (1774); 'Bibliotheca Medicinæ Practicæ' (1776–88).

Haller is considered one of the greatest German poets of the 18th century. His philosophical and descriptive poems display depth of thought and richness of imagination. His 'Elegiac Poems' (Die elegischen Gedichte) are still frequently republished in Germany. He wrote in prose three philosophico-political romances — 'Usong,' 'Alfred the Great,' and 'Fabius and Cato' — designed to exhibit the respective advantages of different forms of government, and corresponded in German, Latin, Italian, English, and French with all parts of Europe.

Hal'lett, Benjamin Franklin, American statesman: b. Barnstable, Mass., 2 Dec. 1797; d. Boston 30 Sept. 1862. Graduated from Brown University in 1816, he studied law, was admitted to the bar, and was connected with the Providence (R. I.) press, but later went to Boston, and there became editor of the Boston *Advocate*, the official mouthpiece of the Anti-Masonic party. From 1827 to 1831 he edited the Boston *Daily Advertiser*, which he made extremely unpopular through his vigorous enunciation of his views on masonry, temperance, and emancipation. He afterward became a Democrat and an influential factor in his party. For years he was chairman of its national committee, and it was he who drafted the Cincinnati platform of 1856. President Pierce, whose nomination he had helped to secure, appointed him United States district attorney in 1853.

Hal'lettsville, Texas, city, county-seat of Lavaca County; on the San Antonio & A. P. railroad; about 100 miles southwest of Houston. It is in an agricultural and stock-raising region, and special attention is given to cotton and cattle. It has a cotton-seed oil mill and a number of cotton-gins. Large shipments are made each year of live-stock, cotton, and cotton-seed oil. Pop. (1900) 1,457.

Halley, hăl'ĭ, **Edmund,** English mathematician and astronomer: b. Haggerston, near London, 29 Oct. 1656; d. Greenwich, Kent, 1742. Before he was 19 he published 'A Direct and Geometrical Method of Finding the Aphelia and

Eccentricity of Planets,' which supplied a defect in the Keplerian theory of planetary motion. By some observations on a spot which appeared on the sun's disk in July and August 1676, he established the certainty of the motion of the sun round its own axis. August 21, the same year, he fixed the longitude of the Cape of Good Hope by his observation of the occultation of Mars by the moon. In 1679 he published 'Catalogus Stellarum Australium, sive Supplementum Catalogi Tychonici,' etc., and in 1683 his 'Theory of the Variation of the Magnetical Compass,' in which he endeavors to account for that phenomenon by the supposition of the whole globe of the earth being one great magnet, having four circulating magnetical poles or points of attraction. For the purpose of making further observations relative to the variation of the compass he set sail on a voyage in 1699, and having traversed both hemispheres arrived in England in September 1700. The spot at St. Helena where he erected a tent for making astronomical observations is still called Halley's Mount. As the result of his researches he published a general chart, showing at one view the variation of the compass in all those seas with which English navigators were acquainted. He was next employed to observe the course of the tides in the English Channel, with the longitudes and latitudes of the principal headlands, in consequence of which he published a large map of the channel. In 1703 he was elected Savilian professor of geometry at Oxford, and in 1720 he received the appointment of astronomer-royal at Greenwich, where he afterward resided, devoting his time to completing the theory of the motion of the moon. In 1721 he began his observations, and for the space of 18 years scarcely ever missed taking a meridian view of the moon, when the weather was not unfavorable. In 1752 appeared his 'Astronomical Tables,' and he was the author of a great number of papers in the 'Philosophical Transactions.' For the comet called by his name, see COMET.

Halliwell-Phillipps, hăl'ĭ-wĕl-fĭl'ĭps, **James Orchard,** English antiquary and Shakespearian scholar: b. Chelsea, London, 21 June 1820; d. Hollingsbury Copse, near Brighton, 3 Jan. 1889. He was educated at Cambridge. In 1839 he was elected Fellow of the Royal and Antiquarian Societies. Gradually he came to concentrate his studies on Shakespeare alone, and more particularly on the facts of the poet's life, discrediting the internal evidence of the plays and sonnets, and devoting his attention to a minute and patient study of local tradition and the records of 32 towns besides Stratford. The successive editions of his 'Outlines of the Life of Shakespeare' (1848; 8th ed. 1889) recorded the growing results of his discoveries. Apart from Shakespeare, his 'Nursery Rhymes and Nursery Tales of England' (1845), and 'Dictionary of Archaic and Provincial Words' (1847; 6th ed. 1868) will keep his name from being forgotten. His magnificent folio edition of the 'Works of Shakespeare,' probably the richest storehouse extant of Shakespearian criticism (1853–65), was published at a price prohibitive to most students. To the Smithsonian Institute he gave (1852) a collection of accounts, inventories, and bills illustrative of the history of prices current in the years 1650–1750.

Hal'lock, Charles, American journalist and author: b. New York 13 March 1834. He was graduated from Amherst in 1854, was editor of the New Haven *Register* in 1855–6, of the New York *Journal of Commerce* in 1856–61, of the St. John (N. B.) *Telegraph and Courier* in 1863–5. In 1873 he founded 'Forest and Stream,' and in 1896–7 was editor of the 'Northwestern Field and Stream.' In 1874 he founded the International Society for the Protection of Game. He did field-work and collecting for the Smithsonian Institution, and published numerous works, such as: 'The Fishing Tourist' (1873); 'Camp Life in Florida' (1876); 'Vacation Rambles in Michigan' (1877); 'Dog Fanciers' Directory' (1886); 'The Salmon Fisher' (1890). He was a son of Gerard Hallock (q.v.).

Hallock, Gerard, American journalist: b. Pittsfield, Mass., 18 March 1800; d. New Haven, Conn., 4 Jan. 1866. He was graduated from Williams College in 1819, in 1824 founded the Boston *Telegraph* (united with the *Recorder* in 1825), in 1827 purchased a part interest in the New York 'Observer,' and in 1828 became associated with David Hale on the *Journal of Commerce.* A leader in journalistic enterprise, he started (1833) a pony-express between Philadelphia and New York, and operated the Evening Edition, a schooner which met incoming ships at Sandy Hook, and brought foreign news. A pro-slavery man, he was a founder of the Southern Aid Society (1854), intended to succeed the American Home Missionary Society when the latter refused support to slave-holding congregations. In 1861 the *Journal of Commerce* was forbidden the use of the United States mails, and Hallock thereupon sold his interest, and never afterward wrote for the press. He was a founder of the Associated Press.

Hallock, Joseph Newton, American Presbyterian clergyman and religious journalist: b. Franklinville, N. Y., 1834. He was graduated from Yale in 1857 and from the Yale Theological Seminary in 1860, and after holding pastorates of several Presbyterian churches became editor and proprietor of 'The Christian at Work.' Among other works he has published 'The Christian Life' (1890); 'Family Worship' (1892); 'What is Heresy?' (1894); 'Mormonism' (1896); 'Life of D. L. Moody' (q.v.) (1900).

Hallowe'en, hăl-ō-ēn', or **Hallow-Even,** the evening of 31 October, so called as being the eve or vigil of All Hallows, or festival of All Saints, which falls on 1 November. It is associated in the popular imagination with the prevalence of supernatural influences, and is clearly a relic of pagan times. In the north of England, hallowe'en is known as Nutcrack Night. In Scotland the ceremonies of the eve were formerly regarded in a highly superstitious light, and Burns' 'Hallowe'en' gives a humorous and richly imaginative presentment of the usual ceremonies as practised in Scottish rural districts in his day. The principal object of curiosity in consulting the future was to discover who should be the partner in life. Popular belief ascribed to children born on hallowe'en the faculty of perceiving and holding converse with supernatural beings.

Hal'lowell, Richard Price, American author and wool merchant: b. Philadelphia 16 Dec. 1835; d. Medford, Mass., 5 Jan. 1904. He was prominent in the abolition movement, was appointed by Gov. Andrew of Massachusetts special agent to recruit negro regiments, and subsequently was vice-president of the New England Woman Suffrage Association. He published 'The Quaker Invasion of Massachusetts' (1883), etc.

Hallowell, Me., city in Kennebec County, on the Kennebec River, and on the Maine Central railroad; two miles south of Augusta and four miles north of Gardiner. The first permanent settlement was made in 1754. It was incorporated as a township in 1771, and chartered as a city 29 Aug. 1850. At the time of its becoming a chartered city it included within its limits Chelsea, Manchester, and Farmingdale. The city is governed by a mayor and a council of seven members elected annually. It has two banks with a combined capital of $150,000. The industries of the city include granite works, shoe manufactories, glue works, cotton goods, machinery, etc. The Hubbard Free Library and the Maine Industrial School are public institutions. Pop. (1904) 3,000.

Hall'statt Epoch, a name taken from the necropolis of Hallstatt, Upper Austria, not far from Salzburg, and applied to that culture in Europe — parts of Germany, France, Italy, and in Switzerland, Bohemia, etc. — distinguished as the last bronze and first iron stage, dating back at least as far as 1000 B.C. According to some ethnologists in the eastern highlands of the Alps this culture was of a higher evolution than that of a partially Oriental cast in the west during the Neolithic epoch.

Hällström, Ivar, ē'vär hĕl'strėm, Swedish composer: b. Stockholm 5 June 1826; d. there 11 April 1901. He studied law at Upsala, then turned his attention to music, in 1861–72 was director of the institute founded by Lindblad, and from 1881 instructor to the Royal Opera. His works include the operas 'Den Bergagna' ("The Mountain King" 1874); and 'Neaga' (libretto by Carmen Sylva, 1885); cantatas, numerous songs, and an 'Idyle' for orchestra, chorus, and solo voices, for which he received (1860) a prize from the Stockholm Musical Union.

Hallucina'tions, are morbid conditions of mind in which the patient is conscious of a perception without any impression having been made on the external organs of sense. Hallucinations are to be distinguished from delusions, for in these there are real sensations, though they are erroneously interpreted. All the senses are not equally subject to hallucinations; the most frequent are those of hearing; next, according to many, come those of sight, smell, touch, and taste; and hallucinations of several senses may exist simultaneously in the same individual. They may also be complicated with certain delusions. Often even the hallucination of one sense is confirmed by the delusion of another, so that it is neither possible nor necessary always to distinguish hallucinations from delusions. The simplest form of hallucinations of hearing is the tingling of the ears; but the striking of clocks, the sounds of musical instruments and of the human voice are often heard, and in these instances, as in those of the perturbations of the other senses, there must be a diseased sensorium, though there should be no structural derangement of the nerves. Hallucinations are not confined to those whose mental faculties have been alienated, but occasionally assail and torment even the sane. The second Earl Grey was haunted by a gory head, but he could dismiss it at will. Swedenborg had a similar faculty; and Bernadotte, king of Sweden, was besieged in his rides by a woman in a red cloak, being perfectly conscious of the hallucination under which he labored. Lord Brougham proposed that the existence of hallucinations should be established as an authoritative test for the existence of insanity; but, as will have been seen, this would be no test at all. The proportion of the hallucinations of the various senses has been by some tabulated thus: — hearing, 49; vision, 48; taste, 8; touch, 3; smell, 1. All are more frequent in mania than in monomania, and in mania errors of vision are more numerous than those of hearing. See APPARITIONS; DREAMS; GHOSTS; INSANITY.

Hallux Valgus, a deformity of the great toe consisting of a turning of the toe toward its neighbor, with a marked enlargement of the head of the bone. The synovial sac on the inner side of the toe is often chronically inflamed from constant pressure, forming a bunion. Advanced cases may require the excision of the bony outgrowths, but early cases may be relieved by a properly adjusted shoe.

Halmahera, häl-mä-hā'rä. See GILOLO.

Halo, the name given to colored circles sometimes seen around the sun or moon, and to other connected luminous appearances. Sometimes as many as three circles are seen round the sun. A white band across the sun, parallel to the horizon, is also sometimes seen; and sometimes a second white band, perpendicular to the first. These bands form a cross, and stretch out so as to cut the circles of the halo. It is on these bands that parhelia or mock suns are formed. The explanation of halos is complex and difficult. Marriotte attributed the colored rings to refraction of light through small crystals of ice in the air, and calculation appears to confirm his hypothesis. The third circle is probably due to refraction of light that has undergone internal reflection in the crystals in a way similar to that which occurs in the formation of the rainbow. On the other hand, the white bands crossing the sun must be due to reflection of light from the surfaces of the crystals. See LIGHT; PARHELION; SUN.

Halogen, hăl'ō-jĕn, in chemistry, an element, or inorganic radical, which unites directly with a metal to produce a saline substance, such as common salt. The term is usually confined to the elements fluorin, chlorin, bromin, and iodin, and the compound known as cyanogen.

Halophytes, hăl'ō-fīts, a group of plants considered with reference to their habitat, and including those which inhabit salt marshes, and by combustion yield barilla, as *Salsola, Salicornia*, and *Chenopodium*. For further examples see BEACH-PLANTS and DESERT PLANTS.

Hal'pine, or **Halpin, Charles Graham,** American soldier and author: b. Oldcastle, County Meath, Ireland, 20 Nov. 1829; d. New York

3 Aug. 1868. After study at Trinity College, Dublin, he came to Boston, Mass., in 1851, was there assistant editor of the *Post*, and with B. P. Shillaber began the 'Carpet Bag,' an unsuccessful humorous periodical. Later Washington correspondent of the New York *Times*, he then went to New York, where he was connected with the *Herald*, and wrote much ephemeral matter for magazines. Upon the outbreak of the Civil War he enlisted in the 69th New York volunteer infantry, and was afterward on the staff of Hunter as assistant adjutant-general, of Gen. Halleck with the rank of colonel. In 1864 he resigned from the service and was brevetted brigadier-general of volunteers. He was best known for his burlesque verses, written in the character of an Irish private, "MILES O'REILLY," over which pseudonym they appeared. 'Life and Adventures, Songs, Services, and Speeches' was published in 1864, and his complete 'Poetical Works' in 1869.

Hals, häls, **Frans**, Dutch painter: b. Anwerp about 1584; d. Haarlem 7 Sept. 1666. When young he went to Haarlem, where he studied painting under Karel van Mander, and he was one of the civic guard, director of an art school, and chief of the painters' guild. His first dated work is a portrait belonging to the year 1613, his next, the 'Banquet of the Officers of the Haarlem Corps of Arquebusiers of St. George' (1616), one of the earliest pictures belonging to the Dutch school of genre painting, of which Hals is sometimes regarded as the founder. He executed 'The Jolly Trio,' 'Herring Vender,' and 'Fool Playing a Lute,' and seems to have found in genre painting a scope and a possibility of humor much to his taste. He executed also many single-figure pieces, as 'Hille Bobbe' (National Gallery, Berlin; replica in the Metropolitan Museum), and numerous portraits, all of high value artistically. Hals is ranked among the foremost of portrait artists, being notably successful in illuminating the character of the face. Adrian van Ostade, Wouwerman, and Adrian Brouwer were among his pupils. He is said to have been improvident in his habits, and latterly received a pension from the municipality of Haarlem. His brother DIRK, d. Haarlem May 1656, and his son, FRANS HALS, THE YOUNGER, b. about 1620; d. about 1669, were also excellent painters.

Hal'sey, Francis Whiting, American journalist: b. Unadilla, N. Y., 15 Oct. 1851. He was a member of the editorial staff of the New York *Tribune* 1875–80, and was attached to that of the New York *Times* 1880–1902, editing the *Times* 'Saturday Review' from 1896. He has published 'Two Months Abroad' (1878); 'The Old New York Frontier' (1901); 'American Authors and their Homes'; 'Essays'; 'Our Literary Deluge' (1902).

Hal'stead, Murat, American journalist: b. Ross, Butler County, Ohio, 2 Sept. 1829. At 18 he began writing for newspapers, studied at Farmers' College, near Cincinnati, and did local newspaper reporting on several Cincinnati papers. In 1853 he became manager of a department on the Cincinnati *Commercial*. The following year he acquired a pecuniary interest in the paper, which began rapidly to increase in circulation and influence, so that in a few years it was considered one of the most influential newspapers in the West. The *Commercial* combining with the *Gazette*, its rival, the Cincinnati *Commercial-Gazette*, became the recognized organ of the Ohio Republicans. In 1890 he removed to Brooklyn, N. Y., where he edited the *Standard Union*. Later he was a contributor to magazines and special correspondent, and in the latter capacity went to the Philippines during the Spanish-American War. He wrote: 'The Story of Cuba'; 'Life of William McKinley'; 'The Story of the Philippines'; 'History of American Expansion'; 'Life of Admiral Dewey'; 'The Boer and British War.'

Halsted, George Bruce, American mathematician: b. Newark, N. J., 25 Nov. 1853. He was graduated from Princeton in 1875 and since 1884 has been professor of mathematics in the University of Texas. He has published 'Mensuration' (1881); 'Elements of Geometry' (1885); 'Elementary Synthetic Geometry' (1892); 'Pure Projective Geometry' (1895).

Ham, one of the three sons of Noah, from whom the earth after the Deluge was peopled. He is first mentioned between the other two — Shem, Ham, and Japheth; but afterward is expressly designated the younger son of Noah, that is, relatively to the other two. He had four sons — Cush, Mizraim, Phut, and Canaan. The three first traveled southward, and from them chiefly sprang the tribes that peopled the African continent, as Canaan became the father of the tribes that principally occupied the territory of Phœnicia and Palestine. Ham is also used as a designation of Egypt, probably on account of its population having sprung from a son of Ham, and the name Ammon, by which the chief god of the northern Africans was often called and worshipped, may very likely derive its origin from the same source.

Ham, the joint which unites the thigh and the leg of an animal, but more generally understood to mean the cured thigh of the hog. Ham-curing is now an important branch of business, especially in Great Britain and America, and the details of the process are generally the same everywhere. The meat is first well rubbed with salt, and a few days after it is rubbed again with a mixture of salt, saltpetre, and sugar, though sometimes the saltpetre is omitted. After lying in the tub for eight or ten days it is ready for drying. Wet-salting requires three weeks, and dry-salting four. The smoking of hams is carried on in smoke-houses, the meat being hung as high as possible, and subjected to the smoke of a fire kindled on the ground-flat, and which ascends through holes in the flooring. The process of smoking is for the most part carried on in winter, the fire being kept in a smouldering state for five or six weeks. Wood is used in preference to coal in the process of smoking. See PORK.

Ham-beetle, or **Paper-worm**, a small clerid beetle (*Necrobia rufipes*), sometimes a pest of considerable importance because of the occurrence of its larvæ or "worms," the paper-like cocoons and beetles on hams in such numbers as to render them unmerchantable. Its injuries are generally confined to the exterior and are due to carelessness in packing and to the cracking of the ham coverings. This is one of three cosmopolitan species of the same genus, all of which are carnivorous scavengers.

Ham-fly, a name of the cheese-fly (q.v.), due to the occasional appearance of its maggots or «skippers» in the fatty exterior portions of preserved hams.

Hama, hä'mä, or **Hamah,** Syria, the Biblical HAMATH, a very ancient city, on the El-Asi (Orontes), 110 miles northeast of Damascus. It is surrounded by gardens, and has narrow, crooked streets, with houses built of timber, and sun-dried bricks. There are manufactures of yarn and coarse woolens, and a general domestic and caravan trade. Hamath is frequently mentioned in Old Testament history as in conflict with the Assyrians; first as early as 854 B.C. After the Græco-Macedonian conquest it became known as Epiphania. In 639 it was captured by the Moslems. Abulfeda, the Arabian geographer, was prince of Hama from 1310–31. In 1812 Burckhardt here discovered the four Hittite stones, the inscriptions of which are still undeciphered. Pop. (est.) 45,000.

Hamadryad, hăm'a-drī-ăd. (1) A baboon (q.v.). (2) The king-cobra (*Naja bungarus*), one of the Oriental cobras, found from Southern India to China and the Philippines, and closely allied in structure, markings, and habits to the cobra di capello, but much larger, reaching the length sometimes of 13 feet, making it the longest of venomous serpents. It is also the most fierce in disposition, but fortunately is nowhere common, and feeds wholly on other snakes. Consult Fayrer, 'Thanatophidia of India' (1874).

Hamadryads, in Greek mythology, the eight daughters of Hamadryas. They received their names from trees, and are the same as the Dryads (q.v.). They were conceived to inhabit each a particular tree, with which they were born, and with which they perished.

Hamame'lis. See WITCH HAZEL.

Haman, hā'man, a minister of the Persian king Ahasuerus. Because Mordecai the Jew refused to pay him homage, he resolved on the destruction of all the Jews in the Persian monarchy. By falsehood and intrigue he succeeded in obtaining a decree for this purpose; but Esther, the Jewish consort of Ahasuerus, interposed for their deliverance, and Haman was hanged on the very gibbet he had caused to be prepared for Mordecai. His history is contained in the book of Esther.

Hamath, hā'măth. See HAMA.

Hăm'blin, Joseph Eldridge, American soldier: b. Yarmouth, Mass., 1828; d. New York 3 July 1870. Not long after the commencement of the Civil War, he became adjutant of the 5th New York, later was transferred to the 65th, whose commander he soon became, and with which he participated in Sheridan's victorious movements in the Shenandoah. For services at Cedar Creek he was brevetted brigadier-general, and was mustered out in 1866 with full rank of brigadier and brevet of major-general. Subsequently he was active in the affairs of the New York State National Guard.

Hamblin, Thomas Sowerby, American actor: b. Pentonville, near London, England, 14 May 1800; d. New York 8 Jan. 1853. He was early a member of the corps of the Sadler's Wells and Drury Lane theatres, was a tragedian at Bath, Brighton, and Dublin, came to the United States in 1825, appeared at the Park Theatre, New York, and acted in leading American cities. He was manager of several New York theatres, and among his rôles were those of Macbeth, Hamlet, Othello, Rolla, Pierre, Virginius, and Coriolanus. He was esteemed second only to Forrest and the elder Booth, and made the standard drama a feature of his management, under which the Bowery Theatre saw its historic days.

Hamburg, hăm'bėrg (Ger. häm'boorg), Germany, a free city and state of northwestern Germany, the city occupying 30 square miles of the state's total area of 157.18 square miles. The city is the greatest commercial port on the European continent, the chief of the three Hanse towns, and the seat of the upper Hanseatic court. It is situated at the junction of the Alster and the Bille, on the right bank of the northern branch of the Elbe, about 93 miles from the North Sea. With its connecting suburbs Altona and Ottensen it has a river frontage of over five miles. The river is spanned by two fine bridges, and there are numerous bridges across the canals which intersect the east and lower part of the city in all directions, and across the Alster which flows through the city and forms two ornamental pieces of water, the Aussen-Alster and the Binnen-Alster or Alster-Bassin. The latter is surrounded by fine quays, the Alter Jungfernstieg and the Neuer Jungfernstieg, lined with handsome residences, hotels, and stores, and constituting the chief thoroughfare in the city. The harbor accommodation is extensive; the principal quays along the Elbe where the ocean steamships lie are the Kaiser-Quai and the Sandthor-Quai. The boulevards or Anlagen occupy the site of the ancient encircling walls, removed since 1815. The modern portion of the city, rebuilt since the destructive fire of 1842 in a magnificent and expensive style, is in striking contrast to the older low-lying portion, with its back streets, bordered by warehouses, and the meaner class of dwelling houses. The most important public buildings are the Exchange, a noble edifice consisting chiefly of a magnificent hall surrounded by a fine colonnade and containing a large commercial library; the modern Rathaus in Renaissance style, and the Deutsches Schauspielhaus. Among ecclesiastical structures are the 19th century Gothic church of St. Nicholas with a tower and spire 473 feet high; the 18th century Renaissance church of Saint Michael's, with a spire 426 feet high, the 15th century church of St. Catherine's, the 14th century church of St. James, and a fine Jewish synagogue. Besides the numerous private and public schools the educational institutions include the Johanneum institution founded in 1528, containing a college, museums, and the city's extensive library; the Kunsthalle with a large art collection; and zoological and botanical gardens, etc. Among the many charitable and benevolent institutions are well endowed hospitals, orphan, and insane asylums, and there is also an organized system of municipal poor relief. The sewerage system has been modernized, and the general sanitary conditions improved, especially since the severe choleraic epidemic of 1892. The municipal waterworks, dating from 1531, have been added to at various dates and a modern filtering plant installed since 1893; municipal

bath and wash houses are maintained; food [illegible] after; the gas [illegible] plants are civic pr[illegible]; and a large revenue is obtained from the electric [illegible]h are operated by private [illegible].

The importance of Hamburg is due to its great marine commerce, which has been facili[illegible] the engineering enterprises of the in[illegible] the bed of the river, cut[illegible] and since 1890 in the construction at C[illegible]en, at the mouth of the river, of enor[illegible]. Seven railroad lines enter the city, which is connected also by rivers and canals [illegible] nearly all parts of the German empire. In 1900, 12,912 vessels with a net tonnage of 8,148,218 tons entered, and 14,030 with a [illegible] tonnage of 8,203,252 cleared the port. The exports by sea in 1901 amounted approximately [illegible] valued at $454,886,750; the im[illegible]y sea in the same year were approximately 9,701,346 tons, valued at $540,177,750. Raw ma[illegible] [illegible]pecially coffee, and manufac[illegible] articles are the chief imports, the last item [illegible]g also the bulk of the exports. The city's manufacturing interests, though large, are l[illegible] important, including ship-building, iron-founding, tobacco and cigar making, sugar re[illegible] distilleries, breweries, and numerous other d[illegible]tic industries. The banking, exchange, and marine assurance business of Hamburg has b[illegible] on an extensive scale since the establish[illegible] of the Hamburg giro-bank in 1619, and is one of the most important in the world.

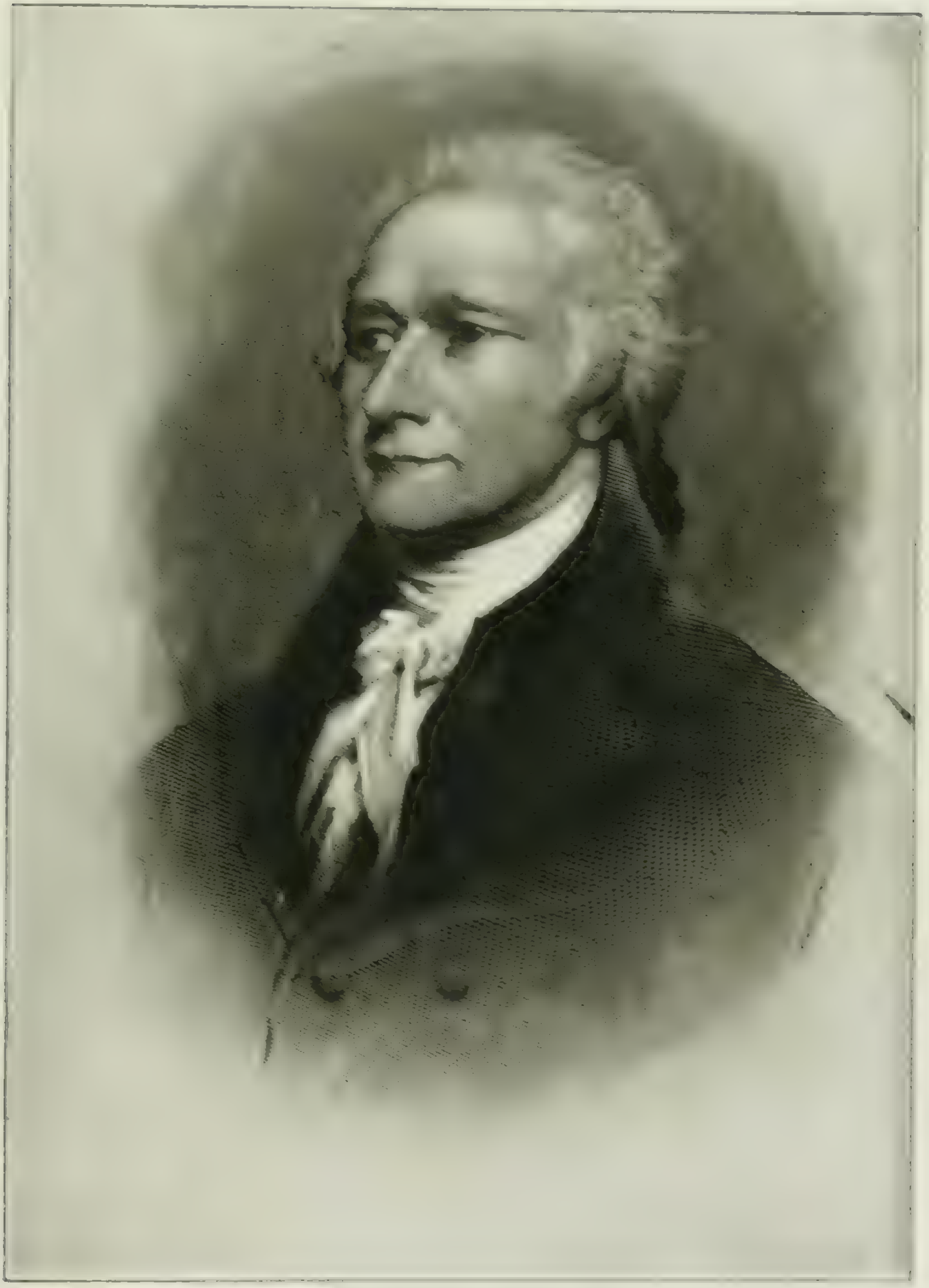
The city-state has a democratic constitution and is administered by an executive senate of 18 life-members, including a first and a second burgomaster elected biennially among the mem[illegible], and by the legislative House of Burgesses composed of 160 members elected every six [illegible] one half of whom retire every three years. The population of the city is second to that of Berlin in the German empire; in 1900 it was 70[illegible].

The city was founded by Charlemagne, who, between 808 and 811, built a citadel and a church on the heights between the Elbe and the east bank of the Alster as a bulwark against the neighboring pagan Slavs. In 831 it became an episcopal see. It was frequently devastated by Danes and Slavs, but in the 12th century had be[illegible] an important commercial city, and in 1241 and 1249 combined with Lübeck and Bremen in forming the Hanseatic League. It was de[illegible] an imperial city by Maximilian in 1510, but was not formally acknowledged until 1618. During the Thirty Years' War its population and p[illegible]rity increased owing to the immunity of [illegible]sition, and in the following century ex[illegible] commercial relations with North Amer[illegible] were developed. In 1810 it was incorporated in the French empire as the capital of the de[illegible] of the Mouths of the Elbe, but was occupied by the Russians in 1813. They were driven out by the French under Davoust, two months later, and the city underwent [illegible] financial spoliation at the hands of the conqueror and extensive depopulation. In 1815 it became an independent state of the German federation, forming with Lübeck, Bremen, and Frankfort, the [illegible] of the free cities. Its trade and im[illegible] have increased ever since. In 1871 it united with the German empire as a free [illegible]: but did not join the Zollverein or German Customs Union until 1888.

Hamburg Fowls. See POULTRY.

Hamilcar, hā-mĭl'kar, a name of common occurrence at Carthage, and borne by several of its most distinguished citizens, among whom the chief was HAMILCAR BARCA ("lig[illegible]": b. Carthage; d. Spain 228 B.C. He was the father of the celebrated Hannibal. While a young man he was appointed to the command of the Carthaginian forces in Sicily, in the 18th year of the first Punic war, 247 B.C. He estab[illegible]ed himself with his whole army on Mount Hercte (now Monte Pellegrino), where he not only succeeded in maintaining his ground, but sent out squadrons to plunder the coasts of Sicily and Italy. In 244 he quitted his strong position, and, landing at the foot of Mount Eryx, converted the town of that name into a fortified camp for his army. For two years he defied all the efforts of the Romans to dislodge him; but the Carthaginian admiral, Hanno, having been totally defeated off the Ægate Islands, 241 B.C., he reluctantly consented to withdraw from Sicily. His inability to perform the promi[illegible] which, to keep them in obedience, he had made to his mercenary troops, brought about their re[illegible]t after returning from Sicily, and as they were joined by almost all the native Africans, Carthage was brought to the brink of ruin. The incapacity of Hanno, who had been entrusted with the suppression of the revolt, led all par[illegible] to concur in the appointment of Hamilcar. He defeated the enemy with great slaughter, reduced their towns to subjection, and after [illegible]eral alternations of fortune, and the appoint[illegible] of Hanno to a share in the command, the war was brought to a successful close, 238 B.C. Hamilcar now projected the formation of a new empire in Spain, to be a source of strength to Carthage, and the point whence hostilities might be renewed against Rome. This policy was ably prosecuted after his death by Hasdrubal and Hannibal. Hamilcar penetrated into the heart of the country, reduced some cities and tribes, and acquired vast wealth. He pas[illegible] nine years in Spain, and fell in a battle against the Vettones.

Hamilton, Alexander, American statesman and soldier: b. Charles Town, in the island of Nevis, W. I., 11 Jan. 1757; d. New York 12 July 1804. His parentage is uncertain, but it is generally accepted that he was the son of James Hamilton, a Scotch merchant in Nevis, and Rachel Levine, the daughter of a French physician. Hamilton's father was unfortunate in his business ventures, and having become a bankrupt it was necessary for Alexander, at the age of 12 years, to earn his own living. He secured a position as clerk in the counting-house of Nicholas Cruger of Saint Croix. His "genius for affairs" was soon apparent, and after two years we find him entrusted with the full management of the business. But ambition for something more than a commercial career had already taken hold of the young man's mind, and he began to write for the local press. A very strong and vivid description of a West Indian hurricane, which had devastated the islands, attracted general attention and aroused the lad's friends to provide the necessary funds



to enable him to come to America to complete his education. He arrived at Boston in 1772, and was put in a school at Elizabethtown, N. J., where he industriously prepared himself for college, and in 1774 he entered King's College (now Columbia University), and made a brilliant record as a student. The friction between England and the American colonies was constantly growing more serious, and after studying the question and being convinced that the colonists were right, Hamilton began the advocacy of their cause in a speech at a public meeting, 6 July 1774. The meeting assembled to discuss the calling of a general congress and was held in the fields (now City Hall Park). He also published two pamphlets, asserting the colonists' position in relation to the Crown and to Parliament, and justifying their appeal to arms. The pamphlets were at first thought to be productions of well-known leaders, and when their authorship became known it gave Hamilton a national reputation. Hamilton now turned his attention to preparation for military service in the Revolution. He secured a commission as captain of the first Continental artillery company and entered the patriot service in March 1776. His natural aptitude for organization and command soon made the company a model of discipline and efficiency. He participated in the battles of Long Island, White Plains, Trenton and Princeton, and won the commendation of his superiors for his skill and courage. On 1 March 1777 Hamilton was appointed lieutenant-colonel and aide-de-camp on the staff of Washington, whose entire confidence he secured, becoming the general's confidential secretary. He took an active part in his chief's battles, assisted in planning campaigns and in devising means for the support of the army, and was entrusted with the important and delicate mission of going to Albany to obtain troops from Gen. Gates (who had previously been ordered to send troops to Washington and had failed to do so) — a duty which Hamilton performed with skill and success. It was while on this mission that he first met Elizabeth Schuyler, the daughter of Gen. Philip Schuyler of New York, whom he afterwards married (14 Dec. 1780). Having received a reprimand from Washington for a supposed delay he took offense and resigned from the staff 16 Feb. 1781. He had no intention, however, of resigning from the Continental Army, and becoming the head of an infantry regiment, he took part in the siege of Yorktown, heading a storming party and capturing one of the strongest British redoubts. The war was now practically ended, and there being no further opportunity for success in the army, Hamilton returned to civil life. He was yet but 24 years old, but by his natural abilities and capacity for leadership he had attained a foremost place among the great men of his day.

The activity of Hamilton's mind is seen in the fact that while still in active military service he found time to study the great questions of government and finance. In a letter to James Duane he clearly set forth his views on the Constitution, that: «Congress should have complete sovereignty in all that relates to war, peace, trade, finance, and to the management of foreign affairs.» A letter to Morris on the establishment of a national bank induced him to offer Hamilton the place of receiver-general of Continental taxes, which he accepted and originated a new system of national taxation. The receiver's office did not prove congenial, and he was relieved of its duties by his election to the Continental Congress from New York 1 Oct. 1782. Congress proved a disappointment. Such were the deplorable conditions then prevailing, the looseness of the Constitution and the financial chaos of the government, that Hamilton's efforts to carry through reforms utterly failed. He resigned from Congress in 1783 and returned to the practice of law in New York, where his melodious voice, dignified deportment and unanswerable logic of reasoning, soon placed him in the highest rank of his profession.

The condition of the States at this time is graphically depicted by Senator Lodge in his 'Life of Hamilton': «Divided among themselves, with no army, no navy, no cohesion, floundering wilfully and helplessly in a sea of unpaid debts and broken promises, bankrupt in money and reputation alike.» To secure some relief the Annapolis Convention (q.v.) was held 11 Sept. 1786, five States only being represented — New York, New Jersey, Pennsylvania, Delaware and Virginia. Hamilton was one of the delegates from New York. This convention adopted an address, drafted by Hamilton, reciting the intolerable conditions and calling for a convention to meet the following May in Philadelphia to form a Federal Constitution. (See CONSTITUTION, FRAMING OF THE.) Upon his return to New York he was elected to the State Legislature which convened in January 1787, and began a fight to induce the State to send delegates to the Philadelphia convention. In this he succeeded, and three delegates were appointed, of which Hamilton was one; but the other two were Anti-Federalists, bitterly opposed to Hamilton's idea of a strong general government. When the convention met the vote of his own State was cast against him on every question; the Anti-Federalists withdrew from the convention, leaving New York without a vote. Hamilton, however, presented his views of a plan of government to the convention — an aristocratic republic, with a president and senators chosen for life, and the State governors appointed by the Federal government. After the presentation of this plan, which found no support in the convention, Hamilton withdrew, only returning to engage in the final debates, and at the close he heartily embraced the work of the convention and signed the Constitution as actually adopted.

The Constitution was still to be ratified by the States. New York was opposed to its adoption. There were numerous internal strifes and jealousies, but with great power and determination, Hamilton combated and won over all opponents in the legislature, and by his essays in the 'Federalist,' assisted by Madison and Jay, he successfully fought the great battle for the Constitution, winning a hostile majority to its support. Of these essays George William Curtis declared they «gave birth to American constitutional law, which was thus placed above arbitrary construction and brought into the domain of legal truth.»

Washington was inaugurated President in April 1789. In September 1789 Congress passed an act establishing a Treasury Department, and Washington at once made Hamilton the first

Secretary of the Treasury. His creative, constructive and practical mind was now confronted with the problem of giving to his country a workable system of national administration. With a master's hand he organized the Treasury Department; reduced the confused finances to order; provided for a funded system and a sound system of national taxation; induced Congress to assume the State debts; authorized methods for the establishing of a national bank and a mint, the raising and collection of internal revenue, the management of the public lands, and the purchase of West Point by the government. In 1791 his Report on Industry and Commerce appeared, wherein he discussed with profound ability and clearness the economic problems of his time, and inaugurated, in a very moderate way, the protective tariff system. His methods to strengthen the national government were vigorously opposed by those antagonistic to centralization, chief among whom was Thomas Jefferson (q.v.), and the controversies that then divided parties have been continued by the rival political parties to the present. Engrossed as he was with the home affairs of the government, Hamilton was nevertheless a deep student of foreign relations and advocated a position of strict neutrality on the part of the American government with regard to the difficulties of nations. He ably sustained Washington in his proclamation of strict neutrality between France and England, both in the cabinet and in the public press, and when M. Genêt, the ambassador of the French republic, tried to involve this country in a war with England, Hamilton was vigorous in his condemnation. It was at this time that Jefferson, then Secretary of State, took sides with editor Freneau of the Philadelphia 'National Gazette,' in his criticism of the administration and especially of the treasury department. Hamilton replied and the controversy became typical of the two great political parties — the Federalists and the Republicans. Jefferson's position in the cabinet was most uncomfortable and he resigned 1 Jan. 1794. In 1794 the Whiskey Insurrection (q.v.) occurred in Pennsylvania in opposition to the excise laws passed by Congress. Hamilton advised a vigorous policy and when troops were sent by Washington against the insurgents, Hamilton accompanied them and the "rebellion" quickly faded away.

Desiring to give more attention to his private interests Hamilton resigned from the Cabinet 31 Jan. 1795. He declined the office of Chief Justice of the United States Supreme Court and returned to his law practice in New York city where he was at once acknowledged the leader of the bar. But he still continued to take an active interest in political affairs. In 1794 Chief Justice John Jay (q.v.) was nominated by Washington as envoy extraordinary to negotiate a commercial treaty with Great Britain. With Lord Granville a treaty was drawn up known as Jay's Treaty (q.v.), the terms of which were so hard and unjust that when the treaty was published there was a violent outburst of indignation. Hamilton, however, in a series of essays signed "Camillus," defended the treaty as the best obtainable and after a severe struggle in Congress it was ratified. Washington thoroughly appreciated the judgment and genius of Hamilton, often consulted him on important matters, and received much help from him in the preparation of his messages and speeches. The "Farewell Address would have been less perfect as a composition," says Renwick, "had it not passed through the hands of Hamilton."

Hamilton had supported John Adams (q.v.) for the Presidency, but Adams was jealous of the power and influence of Hamilton over members of the Cabinet, and made war upon him, expelling his friends from office and assailing him personally. Hamilton blamed Adams for the loss of the elections in New York State, and denounced him bitterly. Adams was renominated in 1800 for the Presidency, but he was beaten by Jefferson, and the Federalist party never won another election. Owing to a defective clause in the Constitution (see JEFFERSON-BURR IMBROGLIO) the election was thrown into the House of Representatives, Jefferson and Burr having received an equal number of votes Hamilton exerted his great influence with the Federalists and Jefferson was elected.

In 1804 the Federalists nominated Aaron Burr (q.v.) for Governor of the State of New York. The contest was a bitter one and again Hamilton was instrumental in Burr's defeat, and the latter challenged him to a duel on the ground of an alleged insult. Under the idea that the continuance of his personal influence and the peculiar condition in which the affairs of the country were at the time demanded his acceptance of the challenge, he consented to meet Burr, and the duel was fought at Weehawken, N. J., 11 July 1804. Hamilton was wounded and died the following day, universally mourned by his countrymen.

American history presents no more striking character than Alexander Hamilton. He was not popular, nor did he strive after popularity, but after 100 years his name still holds a noble eminence. He lived for the public good. Eloquent and refined, able and brilliant, the embodiment of devotion, integrity and courage, he has left as deep a mark upon our political institutions as any other statesman our country has produced. Hamilton's works were published by H. C. Lodge in nine volumes (1885–6). Consult: Hamilton, 'History of the Republic of the United States as Traced in the Writings of Alexander Hamilton and His Contemporaries' (4th ed. 1879); Morse, 'Life of Alexander Hamilton' (2 vols. 1876); Lodge, 'Alexander Hamilton' (1882). For his writings, etc., consult 'Bibliothica Hamiltonia' (1886).

GEORGE EDWIN RINES,
Editorial Staff 'Encyclopedia Americana.'

Hamilton, Andrew, American lawyer: b. Scotland about 1676; d. Philadelphia 4 Aug. 1741. His early career is unknown. He was for a time called Trent, and it is not certain at what period he took the name of Hamilton. About 1697 he appeared in Accomac County, Virginia, where he opened a classical school. In 1716 he went to Philadelphia, the next year became attorney-general of Pennsylvania. From 1721 to 1724 he was in the provincial council, and in 1727 was elected from Bucks County to the provincial assembly, continuing to hold his seat, with a year's exception, until 1739, and in 1729 was speaker. He is best known for his gratuitous defense of John Peter Zenger, a New York printer, who was charged with libel in

publishing in a newspaper owned by him statements regarding the interference by the governor with the process of the law-courts. Hamilton's defense was based on the truth of the statements in the alleged libel. He was successful, was granted the freedom of New York, and, having thereby secured a freer discussion of public officers, was termed by Morris the "day-star of the Revolution." He became judge of the vice-admiralty court of Pennsylvania in 1737.

Hamilton, Anthony, COUNT, English courtier, and man of letters: b. probably Roscrea, Tipperary, Ireland, 1646; d. St. Germain-en-Laye, France, 6 Aug. 1720. He was descended from a younger branch of the family of the dukes of Hamilton in Scotland. His parents were Catholics and Royalists, and removed to France after the death of Charles I., and young Hamilton became domiciliated there. He, however, made frequent visits to England in the reign of Charles II. His sister was married to Count Grammont (q.v.). On the ruin of the royal cause he accompanied James to France, where he passed the rest of his life. Hamilton is chiefly known as an author by his 'Memoirs of Count Grammont,' a lively and spirited production, exhibiting a free and, in the general outline, a faithful delineation of the voluptuous court of Charles II. It is an admirable chronicle of the frivolous life of the French and English courts of that time. His other works are 'Poems' and 'Fairy Tales,' which, as well as the 'Memoirs,' are in French, and are really masterpieces of grace and sprightliness.

Hamilton, Edward John, American educator: b. Belfast, Ireland, 29 Nov. 1834. He was graduated at Hanover College, Indiana, in 1853, and at Princeton Theological Seminary in 1858; was professor of mental philosophy at Hanover College in 1868–79, and of philosophy at Hamilton College, Clinton, N. Y., in 1883–91. In 1895 he became professor of philosophy in the State University of Washington. He is the author of what is known as 'Perceptionism' (a system of metaphysical philosophy), and has published 'A New Analysis of Fundamental Morals' (1870); 'The Human Mind' (1883); 'The Modalist' (1883); 'The Perceptionalist or Mental Science' (1899).

Hamilton, Frank Hastings, American surgeon: b. Wilmington, Vt., 10 Sept. 1813; d. New York 11 Aug. 1886. He was graduated from the medical department of the University of Pennsylvania in 1833; in 1861 went to the war as surgeon of the 31st New York volunteers, was made brigade surgeon after the battle of Bull Run, and surgeon of Gen. Keyes' corps in 1862. A year later he became medical inspector of the United States army. He was one of the founders of Bellevue Hospital Medical College in 1861, and was professor of surgery there till he resigned in 1875. Dr. Hamilton was associated with Drs. Agnew and Bliss in the care of President Garfield. He wrote on the principles and practice of surgery three works, regarded as standard on the subjects treated: 'Treatise on Fractures and Dislocations' (1860); 'Practical Treatise on Military Surgery' (1861); and 'The Principles and Practice of Surgery' (1872).

Hamilton, Gail. See DODGE, MARY ABIGAIL.

Hamilton, Gavin, Scottish painter: b. Lanark, Scotland, 1730; d. Rome, Italy, 1797. Sent when very young to Rome, he there devoted himself during the remainder of his life to historic painting. One of his greatest works was his 'Homer,' consisting of a series of pictures representing scenes taken from the 'Iliad.' He published in 1773 'Schola Picturæ Italiæ,' composed of a number of fine engravings by Cunego, making part of the collection of Piranesi; he there traces the different styles from Leonardo da Vinci to the Carraccis; all the drawings were made by Hamilton, and this admirable collection now forms one of the principal treasures in the first libraries in Europe. He spent the latter part of his life in conducting archæological excavations in various localities near Rome.

Hamilton, LORD George Francis, English politician: b. Brighton 1845. He was a Conservative member of Parliament for Middlesex in 1868–85, for Ealing division in 1885–1902, in 1874–8 was under-secretary of state for India, and in 1878–80 vice-president of council. In 1885–6, and again in 1886–92 he was first lord of the admiralty, and from 1895 until his resignation in 1903 was secretary of state for India. His naval reconstruction plan of 1889 was the most extensive of the kind ever adopted by Great Britain. As secretary for India he displayed great ability in dealing with the numerous difficulties which arose during his administration.

Hamilton, James, American statesman: b. Charleston, S. C., 8 May 1786; d. at sea 15 Nov. 1857. He was educated for the bar, but entered the army and served with credit as a major in the Canadian campaign of 1812. At the end of the war he resumed the practice of law in Charleston. For several successive years Hamilton was chosen mayor, or, as it was then termed, intendant of Charleston. To his vigilance and activity was chiefly due the detection of a formidable conspiracy in 1822 among the negro population, led by Denmark Vesey, a free mulatto from Haiti. In the same year he was elected to the State legislature, and was also chosen a representative in Congress, of which he soon became a prominent and popular member. He became noted for intense and energetic opposition to the protective system and favored direct taxation, regarding all indirect processes for raising revenue as frauds upon the people, and as disparaging to the popular intellect, as well as popular morals. He quitted Congress to become governor of South Carolina in 1830, at a period when the State had resolved upon nullifying the tariff laws of the federal government. On the settlement of this question by Clay's compromise, Hamilton retired from public life for a time. Later he became interested in the cause of Texas, to which he devoted his personal services, and a large portion of his private fortune. In 1841, while Texas was an independent republic, he was her minister to England and France, where he procured the recognition of her independence. On the death of Calhoun in 1852, he was appointed his successor in the United States Senate, but declined the office.

Hamilton, John Church, American biographer and historian, son of Alexander Hamilton (q.v.): b. Philadelphia 1792; d. 1882.

Besides editing his father's works (1851), he wrote: 'Memoirs and Life of Alexander Hamilton' (1834-40); 'History of the Republic' (4th ed. 1879); 'The Prairie Province' (1876), sketches of travel.

Hamilton, John Taylor, American Moravian clergyman: b. Antigua, W. I., 30 April 1859. He was graduated from the Moravian College, Bethlehem, Pa., in 1875, and from the Moravian Theological Seminary there in 1877. He was pastor of the Second Moravian Church in Philadelphia, 1881-6, and has been a resident professor at the Moravian College and Seminary from the latter date. He has published 'History of the Moravian Church in the United States' (1895); 'History of the Moravian Church during the 18th and 19th Centuries' (1900); 'History of Moravian Missions' (1900).

Hamilton, John William, American Methodist bishop: b. Weston, Va., 18 March 1845. He was graduated from Mount Union College (Ohio) in 1865, and from Boston University in 1871, was ordained an elder of the Methodist Church in 1870. He was subsequently pastor of various congregations, including that of the People's Church, Boston, founded by him. In 1900 he was appointed bishop. He was corresponding secretary of the Freedmen's Aid and Southern Education Society (1892-1900), and has published 'Memorial of James Lee' (1875); 'Lives of the Methodist Bishops' (1883); 'People's Church Pulpit' (1884); and other works.

Hamilton, Kate Waterman, American novelist: b. Schenectady, N. Y., 12 Nov. 1841. Since 1870 she has lived in Bloomington, Ill. She is the author of 'We Three'; 'Vagabond and Victor' (1879); 'Rachel's Share of the Road' (1882); 'Tangles and Corners' (1882); 'The King's Seal' (1887); 'The Parson's Proxy' (1896); 'The Kinkaid Venture' (1900); 'How Donald Kept Faith' (1900); etc.

Hamilton, Patrick, Scottish reformer and martyr: b. probably Glasgow about 1504; d. St. Andrews 29 Feb. 1528. Adopting during a short residence on the Continent, the principles of the Reformation, when he settled at St. Andrews in 1523 he naturally cherished his new convictions, and in 1526 announced them with a decision that attracted the notice of Archbishop Beaton, who proceeded to have him formally summoned, and put on his trial. Hamilton had meanwhile fled to Germany, where an intimacy formed with Luther and Melanchthon deepened his convictions, and after an absence of six months he returned to Scotland. He openly preached in the neighborhood of Linlithgow, and Beaton, under pretense of a friendly conference, contrived to allure him to St. Andrews in January, 1528. The early stages of the conference were marked by a conciliatory spirit, but he was led into damaging avowals of opinion, and the result of his trial, on the last day of February, was that he was convicted of divers heresies, and delivered over for punishment to the secular power, by which he was condemned the same day. In the afternoon he was hurried to the stake in front of the gate of St. Salvador's College, his martyrdom, in the 24th year of his age, having done more to extend the principles of the Reformation in Scotland than his life could have done.

Hamilton, Schuyler, American soldier: b. New York 25 July 1822; d. there 18 March 1903. He was a son of J. C. Hamilton (q.v.) and a grandson of Alexander Hamilton (q.v.). He was graduated from West Point in 1841 and served in the Mexican War and in the Civil War also, becoming a major-general of volunteers in 1862. He was subsequently hydrographic engineer to the department of docks. In 1854 he published 'A History of the American Flag' and in 1877 'Our National Flag, the Stars and Stripes, its History in a Century,' delivered as an address before the New York Historical Society in June of that year.

Hamilton, Sir **William,** Scottish metaphysician; b. Glasgow 8 March 1788; d. Edinburgh 6 May 1856. Having studied with distinction at Glasgow, in 1807 he entered Balliol College, Oxford, where he gained first-class honors, and in 1813 he was admitted to the Scottish bar. His taste lay in a different direction, and while he diligently applied himself to almost every branch of literature, mental philosophy became his favorite study. In 1820 he became a candidate for the chair of moral philosophy in Edinburgh, rendered vacant by the death of Thomas Brown, but was defeated by Professor John Wilson. He was appointed professor of universal history in the University of Edinburgh in 1821, and in 1826 became a contributor to the 'Edinburgh Review,' and enriched it with a series of articles afterward published in collected form, with large additions, as 'Discussions on Philosophy and Literature, Education, and University Reform.' Of these the most celebrated was his 'Critique of Cousin's Cours de Philosophie,' in which was developed that philosopher's doctrine of the unconditioned. Many of these contributions were translated into the leading European languages, and attracted much attention from continental speculators in philosophy. In 1836 he became a candidate for an Edinburgh professorship, and succeeded in gaining the chair — which of all men living he was perhaps the best fitted to adorn — of logic and metaphysics. His zeal and ability in discharging its duties were rewarded by the number of ardent students whom he gathered around him. The fame of the Scottish school of metaphysicians, which had begun to wane, was gradually re-established; and his influence would have been felt to even a higher degree had he not been struck with paralysis in 1844, from which he never recovered so far as to undertake the full duties of his position. His mind, however, retained its vigor, and he endeavored to carry out literary designs he had previously formed. In 1846 he published an annotated edition of the works of Thomas Reid, and in 1854 the commencement of a similar edition of the works of Dugald Stewart. His lectures were published in 1859-61, under the editorship of Mansel and Veitch. His views are chiefly expounded in the 'Discussions' and in the 'Dissertations' appended to his edition of Reid, and are attacked in Mill's 'Examination.' See Veitch, 'Memoir of Hamilton' (1869); 'Hamilton: the Man and his Philosophy' (1883); Seth, 'Scottish Philosophy' (1890).

Hamilton, Sir **William Rowan,** Irish mathematician: b. Dublin 3 Aug. 1805; d. there 2 Sept. 1865. He knew Greek and Latin when only 6, and before he had completed his 14th

1. The Gore, King Street 2. View of Hamilton from Mountain

year had made himself acquainted with 13 languages, among which were Arabic, Persian, Hindustani, Sanskrit, and Syriac. When 10 years old he began the study of mathematics, and at 17 presented a paper to Brinkley, the Irish astronomer-royal, which exhibited such a profound knowledge of mathematics, that the latter declared the author of it to be already the first mathematician of his age. In 1827, the chair of astronomy in Trinity College, as well as the post of astronomer-royal, becoming vacant, Hamilton obtained both appointments, though then only in his 23d year. His life henceforth was exclusively devoted to abstruse studies. He was knighted in 1835; in 1837 was elected president of the Royal Irish Academy, and was an honorary or corresponding member of the principal scientific academies of Europe and America. In 1828 his 'Theory of Systems of Rays' was published. In this his celebrated prediction, on theoretical grounds, of the existence of conical refraction of a ray of light was given to the world. Reasoning on the properties of light, he came to the conclusion that under certain circumstances a ray, instead of being refracted in the ordinary way, should split up into a cone of rays; a phenomenon afterward proved experimentally by Lloyd to take place under proper conditions. In 1834 his 'General Method in Dynamics' was published. In this work and that on 'Systems of Rays' the whole of any dynamical problem is made to depend on a single function and its differential coefficients. Another important treatise of his is 'Algebra looked on as the Science of Pure Time.' He published also 'Memoirs on Discontinuous Functions, or Equations of the Fifth Degree, etc.' But the foundation on which his fame most securely rests is the discovery or invention of the calculus of quaternions, an instrument of extraordinary power in the solution of intricate problems in mathematics and physics. His 'Lectures on Quaternions' appeared in 1853, and in 1866 a posthumous work on the same subject entitled 'Elements of Quaternions.' See Life of Sir William Rowan Hamilton,' by Graves (1883–9), with an Addendum (1892).

Hamilton, Bermuda, a seaport town, the capital of the Islands on Great Bermuda, Long, or Hamilton Island. It has a fine landlocked harbor. Founded in 1790. Pop. (1901) 2,246.

Hamilton, N. Y., a village of Madison County, 29 miles southwest of Utica, on the New York, O. & W. R.R. It is the seat of Colgate University (q.v.). It is in a good agricultural region, contains a lumber yard and canning factory, and has a stone quarry, from which the stone for the construction of most of the University has been taken. Hamilton was first settled in 1792, was separated from the township of Paris in 1795, and named in honor of Alexander Hamilton; the village was incorporated 12 April 1816; in 1895 a fire destroyed the business portion of the town, in which the village records were lost. Later in the same year, waterworks and an electric lighting plant were established, which are owned and operated by the town. In 1903 a free library was opened by the Library Association, and it is intended to make it a public library supported by the village corporation. (Pop. 1900) 1,627.

Hamilton, Ohio, city, county-seat of Butler County; on the Great Miami River, the Miami & Erie Canal, the Pittsburg, C., C. & St. L., and the Cincinnati, H. & D. R.R.'s; about 15 miles north of Cincinnati, and 32 miles southwest of Dayton. Gen. Arthur Saint Clair established here a fort, in 1791, and called it Fort Hamilton, in honor of Alexander Hamilton. It was incorporated as a town in 1810. The excellent water-power has been of great advantage in the developement of the city, as manufacturing is its chief industry, although it is located in an agricultural section. The canal has also contributed to the water-power available for manufacturing purposes. Its chief manufactures are paper, flour, beer, woolen goods, agricultural implements, machinery, tools, and iron. The trade is in the manufactured articles and in tobacco, hay, grain, and vegetables. The government is vested in a mayor, who holds office three years, and a board of control composed of five members, each one of whom is the head of a department of the city's government. They are elected for five years. The city owns and operates the electric light plant, the waterworks, and the gas plant. Pop. (1900) 23,914.

Hamilton, Ont., Canada, city and capital of Wentworth County, situated on the shores of Burlington Bay at the western extremity of Lake Ontario, 40 miles from Toronto, 42 miles from Niagara Falls, and 70 miles northwest of Buffalo. It was laid out and settled in 1813 by G. Hamilton, and is built on a plateau of slightly elevated ground extending around the front of a hilly range from Niagara Falls. Hamilton is connected with a large system of Canadian and American Railways,— the Canadian Pacific, Grand Trunk, Toronto, Hamilton & Buffalo, the Michigan Central, the New York Central, and the Lehigh Valley and Wabash Railways. Hamilton's geographical position at the head of Lake Ontario affords the best shipping facilities to the Northwest Provinces and European markets by water, while her railway facilities are not excelled by any city in the Dominion. She has also become a centre of a complete electric railway system. There are 19 miles of street railway, 110 miles of streets, 60 miles of sewers, and 465 street electric lights. Hamilton is the chief manufacturing city in Canada and is in the centre of a fine fruit-growing district. It manufactures very largely, some of the chief industries being agricultural implements, air brakes, and electrical supplies, belting, boots and shoes, carriages, cigars, tobacco, clothing, drugs, elevators, emery wheels, engine packing, fertilizers, files, fireworks, furnaces, gasoline engines, harness, glue, mats, paints, pottery, soaps, spices, silverware, nails, wine, vinegar, mattresses, wringers, washing machines, and musical instruments. It has 2 cathedrals, 62 Protestant churches, 7 Roman Catholic churches, 15 banks, 18 public schools, 7 separate schools, 2 art schools, 2 convents, a public library, 26 charitable institutions, 4 hospitals, 2 incline railways, 4 theatres, a large insane asylum, 7 parks, a wireless telegraph station, 200 groceries, 5 bands, 2 sewage disposal works, 3 reservoirs, capacity (main) 11,000,000 gallons; 50 social and athletic clubs, about 200 national and secret societies, 100 hotels and 3 daily papers. Pop. (1904) 60,000.

J. Castell Hopkins,
Editor 'The Canadian Annual Review of Public Affairs.'

Hamilton College, an institution located at Clinton, Oneida County, N. Y.; founded by Samuel Kirkland, a Congregationalist missionary, in 1793, as an academy for both white and Indian children. The school was not opened until 1797, although Gen. Frederick William Steuben laid the cornerstone in 1794. Lack of funds prevented the completion sooner, and to the untiring efforts of its founder was due, in a great measure, the success of the undertaking. It was first called Hamilton Oneida Academy, so named in honor of one of its trustees, who was also a benefactor. In 1812 it was chartered by the University of the State of New York as Hamilton College. The school has grown steadily in facilities, keeping well abreast of the times. Two courses are offered: the Latin-Scientific and the Classical. It has fine scientific collections, an astronomical observatory, and well-equipped laboratories. The college has at its disposal 1 fellowship, 55 scholarships, 4 prize scholarships (yielding $200 each), and a number of valuable prizes. The campus, nearly 100 acres, has many notable improvements, gifts from graduates. In 1904–5 there were connected with the school 18 professors and instructors, and 198 students. The library contained about 45,000 volumes.

OREN ROOT,
Registrar.

Hamilton Inlet, Labrador, the estuary of the Hamilton or Grand River (q.v.). It is 150 miles long and has a maximum width of 30 miles. On its north shore is Rigolet, a Hudson's Bay Company trading-post.

Hamilton, Mount. See LICK OBSERVATORY.

Hamilton Series, a series of rocks, including the Hamilton and Marcellus stages and constituting the middle Devonian. The name is from the town of Hamilton, 29 miles south of Utica, N. Y., where the series is typically developed. It consists there of shales and sandstones with a few beds of limestones, the most prominent being the topmost member of the series. The Hamilton, like the other Devonian formations, was laid down along the Atlantic shores of what was then the American continent and in a great interior sea, sedimentation being heaviest in the northeast gulf of this sea. The sea extended from eastern New York to western Iowa. In the west the series is largely calcareous. The series is about 1,500 feet thick in eastern New York and reaches a maximum of 2,000 to 5,000 in Monroe County, Pa. It rapidly thins westward, and the south end of Lake Huron is only 20 to 50 feet thick. At the falls of the Ohio, above Louisville, the series is represented by 20 feet of hydraulic limestone. The rocks forming the high cliffs along the Delaware River south of Port Jervis, Pa., are of Hamilton Age. Outside of the interior basin rocks of Hamilton Age have been determined in the Gaspe region of Canada, where they reach a thickness of 7,040 feet. In the Eureka district, Nevada, is a great but undetermined thickness of Hamilton limestone, and in the Mackenzie River valley in Northwest Territory is a deposit of fully 500 feet of fossiliferous limestone, partly at least of Hamilton Age. From the fossils found it is evident that the plants in the Middle Devonian forests were mostly Acrogens and included giant club mosses or Lycopods, tree ferns and Equisetæ. One tree fern, *Psaronius*, had a trunk four feet thick. The gymnosperms were ancestors of the family of the conifers, being related to the yews. Insects, some of considerable size, abounded. In the ocean brachiopods were the most numerous and characteristic animals. Lamellibranchs were more abundant than in Cambrian time and there were true barnacles. The shallow muddy waters of the eastern part of the interior sea were not favorable to the growth of crinoids and corals, but these were common westward. Of the gasteropods *Platyceras* and *Pleurotomaria* were common genera. See DEVONIAN PERIOD; DEVONIAN SYSTEM and EQUISETÆ.